CAPITALIZING ON PREGNANCY AS A TEACHABLE MOMENT FOR HEALTHY EATING AND DIABETES PREVENTION AMONG CENTRAL AMERICAN IMMIGRANTS IN WASHINGTON, D.C.

by

Katherine Lee, M.A.

A dissertation submitted to Johns Hopkins University in conformity with the requirements for the degree of Doctor of Philosophy

Baltimore, Maryland

June, 2016

A. PREFACE

A.1 Abstract

Background: Innovative and culturally appropriate communication interventions for promoting healthy eating and prevention of diabetes are needed for low income minority populations. A life course approach timed to coincide with transitional events in an individual's life, such as pregnancy, can tap receptivity and motivation to change and result in significant behavior modification. Approximately 7% of pregnant women develop gestational diabetes mellitus (GDM), with higher rates among Latina women. Research investigating pregnancy as a teachable moment for healthy eating can prevent and manage GDM, and potentially prevent later Type 2 diabetes.

Methods: We conducted the research at Mary's Center, a Federally Qualified Health Center (FQHC) in Washington, D.C. under an academic--community collaboration. We used quantitative and qualitative methods (1) to examine gestational weight gain as a predictor of GDM in electronic clinical records for pregnant Latina women at Mary's Center from 2008-2013, (2) to conduct in-depth interviews (IDIs) and chart reviews with Central American immigrant women accessing prenatal care and their health care providers. The total sample comprised 43 IDIs: 13 IDIs with providers, 20 IDIs with pregnant women (10 GDM; 10 non-GDM), and 10 IDIs with postpartum women (7 GDM; 3 non-GDM).

Results: Greater gestational weight gain during the 1st and 2nd trimester of pregnancy was associated with an increased risk of GDM incidence among pregnant Latina women, with stronger effects for obese women. These results signal critical points early in pregnancy as teachable moments for nutritional and weight gain counseling to potentially prevent GDM. Pregnant women perceived a strong link between their eating and nourishing the baby, and were highly motivated to

learn about and make healthy dietary changes. Providers play an instrumental role in capitalizing on pregnancy as a teachable moment particularly to promote sustainable dietary change.

Conclusions: Pregnancy is a potent teachable moment for healthy eating and diabetes prevention. The period of high receptivity and motivation for behavior change holds important implications for promoting healthy eating over the life course and reducing the risk of diet-related chronic disease. The life course approach has potential to reduce health disparities for low-income Latinas.

DISSERTATION COMMITTEE MEMBERS

ADVISOR:

J. Douglas Storey, Ph.D.
Assistant Professor; Health, Behavior & Society

COMMITTEE CHAIR:

Joel Gittelsohn, Ph.D.
Professor; International Health

READERS:

Wendy L. Bennett, M.D.
Assistant Professor; School of Medicine

Katherine C. Smith, Ph.D.
Associate Professor; Health, Behavior & Society

Laura E. Caulfield, Ph.D. (Alternate)
Professor; International Health

Hae-Ra Han, Ph.D., R.N. (Alternate)
Associate Professor; School of Nursing

Brian Weir, Ph.D. (Alternate)
Assistant Scientist; Health, Behavior & Society

A.2 Acknowledgments

I would like to acknowledge the many individuals that made it possible for me to do this work.

To my mother, Pearl – thank you. This is – as it all has been – for you.

To my family and friends - I thank my brother Philip Lee for his constant support over all these years and also for his valuable feedback on this research. I thank my father, Peter Lee, for always supporting my pursuit of studies and for encouraging me to pursue enriching opportunities around the world. To my friends, I first thank my cohort without whom the doctoral experience would not have been half as enriching or fulfilling. Thanks especially to my writing buddies Kisha Coa and Katrina Berg for rewarding weekly sessions. I am appreciative of my strong network of support and particularly these friends who have helped me immeasurably through this process– Rachana Sikka, Victoria Chau, Erin Mead, Caryn Bell, Arvis Layton, Jonathan Zwi, Ron Chen, Kendall Madden, and Anita Mukherjee. To those who I have not named here, but who have indelibly been a part of my journey – thank you for being there.

To my mentors – who have generously given their time, thoughts, guidance, and support to help me become a better researcher – I extend my heartfelt thanks. I am grateful to my advisor, Doug Storey, for his mentorship and support through this challenging and rewarding doctoral process. Thank you for encouraging me in this unique process of intellectual discovery, and for always being a ready and willing audience to my sometimes wide ranging ideas. From the beginning you have encouraged me to explore my multidisciplinary interests, and guided me to think critically and explore new ideas while learning how to focus them strategically. I have learned invaluable lessons in becoming a researcher and you have fostered my enthusiasm for new avenues of inquiry. I walk away from every enriching discussion with at once more clarity and even more intriguing questions - I imagine, the hallmark of good research. I owe many thanks to my mentor Joel Gittelsohn, whose

dedication and conscientiousness to my research process kept me moving steadily along. You went above and beyond in coordinating my involvement with Mary's Center, and helped me develop a qualitative research foundation that has been incredibly fulfilling. Under your guidance I have been able to delve into my interests around food and culture in a community setting, and work with a Spanish-speaking population – all of which I had hoped to explore through my graduate work. I am fortunate to have gained valuable skills through this research that I am excited to further develop in my career, and have learned from you how to think about data in new and engaging ways. I could not have successfully completed this work without you. I also thank all my mentors and especially my committee members past and present – Wendy Bennett, Kate Smith, Lori Erby, Brian Weir, Hee-soon Juon for being such encouraging and inspiring research mentors.

To staff and the University - I am thankful for research support from the Johns Hopkins University Department of Health, Behavior and Society doctoral dissertation award to enable me to conduct the qualitative research. I am also grateful for the funding and mentorship I received from the Center for a Livable Future-Lerner pre-doctoral fellowship that has enriched my doctoral work.
Thank you to the supportive staff in my department, particularly Barbara Diehl, who works tirelessly to make the wheels turn for students in this program. Thank you also to Nancy Martin for seamlessly processing numerous contractors for my research. I am thankful for my fantastic globally positioned transcription team- Angela Cacho Prado, Mayra Pol, and Camila Escobar Garcia. I especially thank Camila for her additional role as research assistant who aided with interpretation of the data.

To Mary's Center - I am grateful to Mary's Center for a fulfilling and productive collaboration and for the invaluable assistance of many parties. Thank you first to Gina Pistulka, Rebecca Robert, and Bethany Sanders who have been dedicated research mentors in this process. I could not have asked for a better team of collaborators. Your insight and support enabled me to bring this project to

fruition that I hope will have productive implications for the Center. Thank you also to Dr. Emmanuel Ayers, Alis Marachelian, and Mindy Greenside for their support and contributions to this research. Working closely with the Center reaffirmed my convictions that research grounded in a caring community truly effects change and improves the lives of its participants. Julien Guttman, nurse manager – thank you for working so tirelessly to provide me with a recruitment and interview space over many months. I owe many thanks to the Medical Assistants at Mary's Center – especially to Maribel Sanchez and Yesenia Castro – for their assistance with recruitment along with all the hard work they do as true bridges to care.

To the participants of this study - Most of all, I thank the participants without whom this work could not have happened. I am grateful to every woman who so generously shared her time and trusted me with the stories close to her heart. This research is for these women whose strength transcends any border. I am truly fortunate to have shared this experience with them and to have learned lessons that extend far beyond the research. Their courage inspires me and will continue to guide me in my future work to uplift our communities. I share my deepest hopes for all of us to "*seguir luchando*," to keep fighting together for better health and pursuit of opportunities.

A.3 List of abbreviations

ACOG - American College of Obstetricians and Gynecologists

ADA – American Diabetes Association

BMI – Body mass index

CAI – Central American immigrant

DPP – Diabetes Prevention Program

FQHC – Federally Qualified Health Center

GCT – Glucose challenge test (GDM screening test)

GDM – Gestational diabetes mellitus

GWG – Gestational weight gain

IADPSG - International Association of Diabetes and Pregnancy Study Group

IOM – Institute of Medicine

MC – Mary's Center for Maternal and Child Care

OGTT – Oral glucose tolerance test (GDM diagnostic test)

T2DM – Type 2 diabetes mellitus

Table of Contents

A.4 List of tables

A.5 List of figures

B. INTRODUCTION

B.1 Burden of Gestational Diabetes

Gestational diabetes mellitus (GDM) is an increasing problem in the United States affecting 18% of pregnancies, under new diagnostic criteria recommended in 2010 by the International Association of Diabetes and Pregnancy Study Group (IADPSG).[1, 2] GDM prevalence as traditionally defined is approximately 7% and varies depending on the population characteristics and screening practices.[3] The traditional GDM definition is the onset or first recognition of abnormal glucose tolerance during pregnancy. [1]

GDM results from a reduced ability of the pancreas to produce sufficient insulin during the insulin-resistance induced by pregnancy, resulting in hyperglycemia.[4] GDM is associated with both maternal and fetal complications, including large babies, cesarean delivery, preeclampsia, perinatal morbidity, childhood obesity, and a seven-fold increased maternal risk of later Type 2 diabetes.[3-4, 6-9, 18] GDM manifests around 24-28 weeks gestation as a result of physiologic changes in pregnancy exacerbated by pre-existing risk factors such as obesity or pre-diabetes.[5] Other risk factors include family history of diabetes, excess gestational weight gain (GWG), poor diet, and low physical activity.[1] In the United States, racial or ethnic minority groups face greater risk of developing gestational diabetes and diabetes compared to non-Latina whites.[1] With the rise of obesity, the incidence of GDM has correspondingly increased and is likely to pose a substantial public health burden.

Notably, women who have had GDM face a seven-fold increased risk of developing Type 2 diabetes in the future, with 20-60% of gestational diabetics developing T2DM in the

[1] Due to increasing rates of overt but unrecognized Type 2 diabetes in young women and lack of routine glucose testing in this age group, the proposed new definition of diabetes diagnosed during pregnancy distinguishes *overt diabetes* (pre-gestational diabetes) from *gestational diabetes mellitus* (developed during pregnancy). The prevalence of GDM depends on the definition used; IADPSG and the American Diabetes Association (ADA) recommend the new definition while the American College of Obstetricians and Gynecologists (ACOG) maintains the traditional definition, which is inclusive of both types.

5-16 years post-pregnancy.[6, 7] The high-risk period during and after pregnancy signals a critical time for lifestyle modification to reduce the incidence of GDM and Type 2 diabetes mellitus (T2DM).[8, 9] Indeed, a synthesis of GDM research needs identified risk factors, prevention, and screening for Type 2 diabetes in women with prior GDM as high priority for future diabetes research.[10] The Diabetes Prevention Program (DPP) clinical trial demonstrated that structured lifestyle interventions are highly effective in reducing the risk of progression to T2DM by half for women with a prior history of GDM.[11] Among DPP participants, however, only 16% of women with a history of GDM were Latinas.[11] More prevention research focused on Latinas is needed in order to identify effective lifestyle interventions.

B.2 Latinas and Diabetes

The burden of diabetes is disproportionately carried by minorities, with Latinas in the United States 50% more likely to be diagnosed with GDM compared to non-Latina whites.[12] Similarly, Latinos face a 50% greater risk of Type 2 diabetes mellitus (T2DM) in their lifetime; the prevalence of T2DM is markedly increasing for Latino Americans and projected to increase by 107% in the Latino American population by 2020, compared to 44% in the general population. Latino American children born today have a 50% chance of developing T2DM in their lifetime.[13] In addition to a higher prevalence, Latino Americans suffer a higher burden of disease compared to the general population; have poorer disease control; higher rates of complications including diabetic retinopathy, nephropathy, and amputations; and have mortality rates due to diabetes that are twice as high compared to non-Latino whites.[13] These alarming statistics underscore the need for culturally tailored prevention and treatment efforts for Latino Americans.

Approximately half of Latina mothers begin pregnancies overweight or obese, and face greater risk for diabetes at each BMI level compared to non-Latina whites.[14] Yet,

relatively few gestational diabetes prevention interventions have targeted Latinas, and no known interventions target the Central American subgroup.[14, 15] Despite great need, few studies differentiate among Latino subgroups to inform unique intervention strategies and culturally appropriate care.[16-19] A homogeneous Latino category overlooks variation in the migration and socio-demographic characteristics of Latino subgroups as well as differences in customs and cultures, which may vary regionally even within the United States.[20] According to the 2010 US Census, Central Americans are the largest Latino group in MD-DC-VA metro area, comprising 21% of the total immigrant population, with El Salvador, Guatemala, and Honduras as the top three countries of origin.[21] Further research is critically needed to develop GDM prevention interventions for Central Americans in the United States given their large numbers and the health disparities they face.

Limited empirical research exists for Central Americans in the United States highlighting social, cultural, or behavioral factors associated with obesity or its co-morbidities. Bowie and Juon's analysis of the 2001 California Health Interview Survey, identified age, number of children, and education as associated with overweight and obesity for 1,019 Central American women.[17] This study is one of the only quantitative analyses of obesity-related predictors for Central Americans in the United States. It is important to identify socio-demographic and behavioral predictors in conjunction with clinical risk factors in order to direct primary prevention strategies for diabetes in high-risk populations. This dissertation study is one of the first to examine predictors of GDM among Central American women in the United States.

Moreover, appropriate weight gain during pregnancy is an important aspect of prenatal counseling in order to prevent adverse maternal and child outcomes. Greater than half of overweight and obese women experience excessive gestational weight gain.[22] Higher pre-pregnancy weight (and BMI) has been well-established in the literature for its

association with greater risk of GDM.[22] Excess gestational weight gain (GWG) is also associated with GDM, though more tenuously. The few studies conducted that examine gestational weight gain as it relates to GDM during pregnancy have generated inconsistent links, potentially due to the wide range of populations. Hedderson and colleagues found that increased weight gain in the first trimester primarily accounted for the association between rate of gestational weight gain and GDM, with a stronger association in overweight/obese and non-white women.[23] A later meta-analysis found excessive gestational weight gain to be predictive of GDM, with no evidence of differential risk by pre-pregnancy BMI category.[24] The evidence has been mixed for effects of reduced gestational weight gain - or even of weight loss- on the risk of maternal and neonatal morbidities for obese women with GDM.[25, 26] Few studies, moreover, have examined the association of gestational weight gain with GDM among low-income Latinas, who face greater risk of developing GDM compared to non-Latina whites.[1, 14, 23]

A revised Institute of Medicine (IOM) report released in 2009 provided recommendations for total and rate of gestational weight gain specific to the pre-pregnancy weight status of women.[27] The IOM report itself, and an Agency for Health Quality Research (AHRQ) systematic review, documented a lack of quality data on gestational weight gain during pregnancy to firmly relate it to GDM in pregnancy.[22, 28] Most of the reviewed studies in the IOM report, however, focused on total weight gain over the entire pregnancy, which includes weight gained after GDM is diagnosed at the end of the second trimester.[22, 24] Research is called for that addresses gaps in the literature to better establish optimal weight gain recommendations.[29] This is the first study to examine gestational weight gain as a predictor of GDM in a low income Latina population of primarily Central American immigrants.

There have also been few qualitative research studies of Central Americans in the United States. Acculturation has been associated with diabetes risk factors among Latinos, with adaptation to a Westernizing diet potentially increasing development of overweight.[16] Immigrants have influences on their diet from their home country as well as the Western diet, which interventions must account for in providing dietary counseling. The salience of Latino cultural values such as allegiance to the family (*Familismo*) and gender appropriate role behavior (*Machismo and Hembriso*) may have bearing on identity construction and social roles.[30] A qualitative study found that religion and folk medicine are important for Dominicans and Puerto Ricans with diabetes, with a majority believing they had diabetes because it was God's will.[31] More research is needed to explore salient cultural values among Central Americans and how these may inform diabetes prevention strategies. This dissertation study is the first known in-depth qualitative exploration of dietary and behavioral factors among Central Americans in the United States to inform diabetes prevention strategies.

B.3 Effectiveness of Diabetes Prevention

Despite great need for diabetes prevention, systematic reviews show moderate evidence for behavioral interventions during pregnancy.[32, 33] Overall, researchers call for higher quality studies with larger sample sizes that take into account psychological factors related to pregnancy.[14, 34-36] A variety of psychosocial factors contribute to variation in individual behavior. Despite the importance of diet in reducing GDM incidence or progression to T2DM, individual adherence to dietary recommendations varies.[37, 38] In part, gestational diabetics may lack knowledge regarding their risk of future T2DM and the need for lifestyle modification, underscoring the role of health providers.[39] Providers have responsibility for the assessment and communication of chronic disease risks to improve preventive behaviors.[40] Psychosocial antecedents such as risk perception and self-efficacy

also affect behavioral adherence.[38, 41, 42] Studies on barriers for GDM self-management among low-income women have identified time pressures, physical and social constraints, limited comprehension of requirements, and insulin as a perceived easier option.[43] Further contextual insight into the psychosocial, interpersonal, and environmental barriers and facilitators of diabetes prevention behaviors is needed for identifying intervention opportunities.

The elements of risk communication, and the manner in which individuals receive and process it, adds further complexity to associated decision-making. The perceived risk of developing diabetes in early adulthood may be a function of beliefs about inherited and behavioral risk factors over the life course.[41] Studies have also found that despite understanding the link between GDM and progression to T2DM, many women still do not perceive themselves to be at risk.[44] Prevention efforts must also take health literacy into account, as limited health literacy (inclusive of oral literacy) and numeracy alters risk perceptions, impedes access to treatments, lowers satisfaction, and impairs risk communication.[45, 46] Health literacy tends to be low in the general population and often among the most vulnerable.[47] Researchers have suggested that providers make use of various tools such as visual aids and appropriate framing of health information to address the low literacy of vulnerable populations and accurately communicate risk.[40, 45] In this dissertation study, I explore health communication strategies for healthy eating and diabetes prevention for the informational and motivational needs of Central American immigrants. These communication strategies may ultimately be applied to the general population based on the specific needs of the study population and setting.

C. CONCEPTUAL FRAMEWORK

C.1 Capitalizing on Teachable Moments in the Life Course

The dissertation research was guided by several theoretical perspectives: the Life Course Perspective, the Temporal Self-Regulation Theory (TSRT), and the Dual Processing Theory of decision-making.[48-50] Integration of these perspectives acknowledges the multi-level framework of influences, the complexity of behavior change (e.g. time perspective and temporal discounting) in long-term chronic disease prevention, and the understudied role of affect and emotion in health communication. The life course perspective is presented here to set up the broad framework; the latter theoretical perspectives will follow in Section D.

The life course perspective, introduced in the 1960s by sociologist Glen Elder, is defined as "a sequence of socially defined events and roles that the individual enacts over time."[51] Life course perspective holds that individual lives are influenced by their constantly changing historic context, that the study of human lives necessitates new ways of thinking about their pattern and dynamic, and that concepts of human development should extend to processes across the life span.[52] The life course perspective is defined by the explicit inclusion of time and multi-level influences in a socio-ecological model, and has been fittingly applied to chronic disease epidemiology.[48]

When applied to health promotion, life course approaches have been posited as a way to alter diet and obesity and to reduce health disparities by addressing racial/ethnic differences beginning in early life.[53,54] The life course provides a compelling framework for diabetes prevention, given the progression of illness and accumulation of risk or protective factors over the lifespan.[48] Considering the life course prevention of GDM and later T2DM, the initial pregnancy period may effectively bring together health services, individual motivations to engage in healthy behaviors, presence of short-term and chronic disease

risk, and activation of social influences to support lifestyle change. These concepts of human development necessarily extend to life span disease epidemiology.

A way to conceptualize the life course framework for diabetes prevention is through teachable moments. The concept of a *teachable moment* refers to an event or circumstance in an individual's life, often a naturally occurring life transition, that may motivate individual adoption of healthy behavior changes.[55] Research that identifies teachable moments may have broad implications for life course prevention of chronic disease by identifying critical intervention points of public health significance. My dissertation research explored pregnancy as a teachable moment for diabetes prevention among low-income urban Central Americans in the Washington, D.C. metropolitan area to cultivate healthy behavior changes and reduce health disparities.

C.2 Pregnancy as a Teachable Moment

Researchers suggest focusing on pregnancy as a teachable moment considering both the mother's potentially heightened receptivity and motivation to improve her health (and the health of her baby) as well as the increased likelihood of clinical contact during that period and the opportunities for intervention it presents.[34, 56] Emerging research supports the potential of pregnancy as a teachable moment for healthy lifestyle behaviors. A qualitative study examined barriers for mothers from low socio economic and migrant backgrounds. Despite greater difficulty with self-management of GDM, mothers' self-management was facilitated by thinking about the baby and psychological support obtained from partners and families.[43] A qualitative study on smoking cessation during pregnancy found that women cited health concerns for baby and self as reasons for wanting to quit, as well as social pressure not to smoke.[57]. Despite the strong support of the teachable moment for smoking cessation interventions during pregnancy, research has yet to translate the

concept to healthy eating, physical activity, or obesity prevention.[34, 56] I investigate this concept in the study population of pregnant Central American immigrants in a health care setting.

McBride et al. posited a model for teachable moments as events that

1) Increase perceptions of personal risk and outcome expectancies;

2) Prompt strong affective or emotional responses, and

3) Redefine self-concept or social roles."[55]

The more domains an intervention covers, the likely greater potential for behavior change. With respect to these three domains, "pregnancy creates a highly personal experience bearing risk to both mother and child and increases the perceived value of healthy eating and exercise."[34, 55] The emotional period may influence a mother's judgment about the significance and meaning of an event and decision-making and potentially redefine her social roles both as mother and partner within a household.[34] Conceptually, the pregnancy transition is a promising time for addressing healthy dietary change.

From a public health perspective, pregnancy is also compelling as a teachable moment for chronic disease prevention counseling. The gestational period of nine months brings women into health facilities for an intensive and consistent schedule of care that creates ample opportunity for intervention. The regular monitoring and weekly to biweekly consultations have the structural potential to integrate chronic disease counseling into clinic visits for patients already primed to consider health and wellness. Moreover, pregnancy is often one of the first intensive interactions with the health care system, marking a natural life course opportunity for chronic disease screening and counseling. In a global context, a 7-year population-wide communication program in Egypt successfully intervened at the transitional point of marriage to promote a constellation of family

planning and family health behaviors among newlyweds, capitalizing on engagement with health services and decisions around re-formulated social roles.[58]

In Figure 1, the central focus of the proposed research is magnified, highlighting the pregnancy and family transition period as a teachable moment and the decisions and behaviors surrounding it.

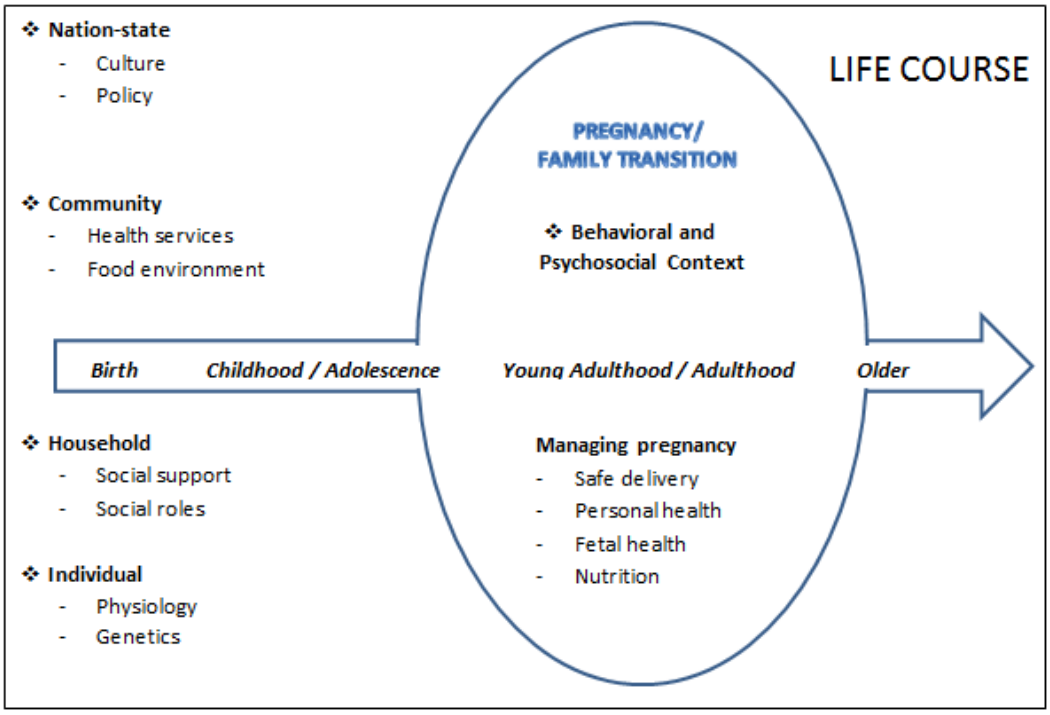


Figure 1: Conceptual Model for Life Course Diabetes Prevention focused on Pregnancy

Taken together, more research is needed to develop effective health communication strategies- taking into consideration the optimal time, channels, messages, and presentation- that may catalyze behavior change and improve diets for immediate and long-term diabetes risk reduction. As in other parts of the life course, dietary behavior change remains elusive; the framework posed here suggests a promising and innovative method that can yield positive population wide outcomes. Since improving maternal diets often

produces corresponding improvements in family and child health, this strategy likely enhances an intervention's impact for population diabetes reduction.[34, 59] This dissertation study is the first to explore pregnancy as a teachable moment for healthy eating promotion and diabetes prevention among Central Americans in the United States.

C.3 Provider Creation of Teachable Moments

Further research to identify mechanisms that facilitate teachable moments will facilitate application of the concept to intervention research. A concept analysis posited that provider-patient interaction may be central to the creation of teachable moments for health behavior change, through a process of co-creation.[60] Research that examines how the teachable moment is created through the interactional process will advance its utility and theoretical value.[60] Studies have shown that provider advice about weight gain during pregnancy is associated with actual weight gain, and can prevent high postpartum weight retention and future obesity.[34, 61, 62] Yet, provider counseling on gestational weight gain (GWG) and physical activity remains largely unexplored.[63] Studies have also shown inconsistency of provider recommendations and lack of expressed concern regarding GWG, though women may desire and value provider advice.[63] The translation of research into clinical practice presents challenges (e.g., patient adherence, multiple providers, limited counseling time), necessitating further investigation into the most effective modes of dissemination.[34, 64] A recent patient-provider communication study coded encounters using the Roter Interaction Analysis System (RIAS) and found that Latino patients rated their visits more positively than non-Latino whites, despite an indication of less communication about psychosocial issues.[65] Further exploration of the role of providers in creating a teachable moment merits accounting for potential differences in cultural preferences, communication style, and expectations of provider counseling.

A greater understanding of patient and provider perspectives is needed to identify mechanisms that make pregnancy a teachable moment for diabetes prevention. In this dissertation study, I explored the role of providers in facilitating creation of teachable moments with pregnant Central American immigrants.

D. THEORETICAL PERSPECTIVE

D.1 Behavioral Theory for Chronic Disease Prevention

Prevention of obesity-related chronic disease has proved to be challenging to health interventionists and behavioral scientists alike. Despite the clear scientific evidence for healthy eating and physical activity as critical to prevention of obesity and diabetes, these health behaviors remain one of the most persistent challenges for health promotion.[49] Factors at the household, community, and policy level significantly influence dietary choices, such as access to healthy foods; however, increasing individual demand for healthy foods also remains problematic.[66, 67] Given the existing gaps in diabetes prevention research, novel approaches are needed to increase risk perceptions and translate it into preventive behaviors.[9, 68] Researchers urge critical examination of diabetes communication in collaboration with behavioral scientists in order to identify innovative and effective strategies.[69] It remains clear that more theoretical investigation is needed in order to understand the motivational and psychosocial processes that shape dietary decision-making and behavior.[70, 71]

D.2 Temporal Self-Regulation Theory

A notable characteristic of chronic disease, compared to acute illnesses, is the greater time gap (years or sometimes decades), between risk behaviors and manifestation of illness. Psychological perceptions of risk and preventive health behaviors necessarily face

a challenging trade-off between near-term and long-term costs and benefits. Hall and Fong formulated the Temporal Self-Regulation Theory, stating that "rationality of human behavior largely depends on the temporal frame adopted; behaviors judged to be maladaptive in the long-run are usually driven by a strongly favorable balance of immediate costs and benefits." While TRST applies to many classes of "self-defeating" behaviors that may include maladaptive relationship patterns and poor spending habits, the authors note that "health behavior constitutes perhaps the single most pervasive and insidiously lethal class of self-defeating behavior(38)." [49] In the behavioral literature, the notion of temporality is well represented, captured conceptually in psychology and behavioral economics as time perspective, time preference, inter-temporal choice, delay or hyperbolic discounting, and temporal framing of self-regulatory processes.[72-75] I use the term "temporal salience" to characterize the role of time in decision-making, and define it as the perceived proximity of an event (e.g., developing T2DM) in the life course. For instance, the temporal salience of diet-related chronic disease may be higher for individuals who are diagnosed with GDM compared to those who have older relatives developing T2DM. The perceived immediacy or delay to a negative event may impact perceived risk and, in turn, associated risk-reduction behaviors.

This dissertation study adapts a temporal framework that allocates risk across several time periods. In the case of diabetes during pregnancy, the typically distant risk of T2DM uniquely bears short-term relevance given that manifestation of GDM during pregnancy increases the risk of progressing to T2DM even in the few years following the index pregnancy. The conceptualization of temporality may thereby facilitate a risk perception of greater salience for near term outcomes, in a favorable cost-benefit scenario. Moreover, a healthy diet not only prevents diabetes long-term, but also aids in preventing immediate risk of GDM- and other health complications for mother and baby- during the

gestational period. The affective and emotional experience surrounding pregnancy may thus factor in to decision-making. Temporal salience is a key aspect to explore for its impact on risk reduction behaviors in order to develop effective health communication strategies.

D.3 Dual Processing Theory of Decision-Making

Dual processing theory of human cognition postulates that two systems govern processes of reasoning and decision-making (1) an intuitive, experiential, affective system (System I) and (2) an analytical, deliberative processing system (System II).[50, 76] Kahneman coins these system I and system II; they are also known as Type I and Type 2 processing.[50] Tversky and Kahneman's seminal work describes heuristics, essentially cognitive shortcuts, which "reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations." [77] These often useful heuristics that humans rely on in decision-making also may result in systematic errors; they explain a vast range of seemingly counterintuitive human behaviors and provide evidence that System 1 drives human behavior in ways often hidden to awareness.

Researchers have recently developed formal models that integrate these two systems, including one model specifically for medical decision-making. [50, 78] Current medical communication is based largely on expected utility theory, where decision-makers select among alternatives with different probabilistic (rather than time-discounted) weights of utility. [50, 79] Yet individuals reliably do not follow this model under certain configurations of choices regarding probability and time.[79]

Similarly, health behavior theory models, such as the Health Belief Model (HBM), poses that high perceived susceptibility, high perceived severity, high perceived benefits, and low perceived barriers lead to a high probability of adopting the recommended action.[80] HBM, along with other social-cognitive models such as Bandura's Social Cognitive Theory and Ajzen's Theory of Planned Behavior, largely contribute to the theoretical base of risk

communication.[80] The fundamental emphasis of these models in risk communication is on the cognitive mechanisms used to process risk information and accordingly enact behavioral changes. In the case of communicating chronic disease risk, however, a dominant reliance on System II may not as effectively translate to behavior change, since repeated actions are called for, temporal discounting exists in evaluating near vs. long term costs and benefits, and uncertainty from gradual manifestation of chronic illness may negatively position behavioral constructs (e.g., increase barriers, diminish perceived susceptibility) and impede translation to healthy lifestyle behaviors.

D.4 Emotion in Health Communication

Affect is important for successful risk communication; as affect influences risk perception while System I is also affected by emotions.[81, 82] Affective responses occur rapidly and automatically; the *affect heuristic* coined by Slovic characterizes reliance on these feelings.[83, 84] In this context, affect is "(1) experienced as a feeling state (with or without consciousness) and (2) demarcates a positive or negative quality of a stimulus(397)."[83] While System I assesses benefits and harms, it likely does so using gestalt representations rather than the use of precise numeric values characterized by System II, bearing implications for risk communication.[85] It is important to note that behavior results from a complex interaction of both systems.[50] Moreover, the way in which risks are presented for affect-laden events can either decrease or increase the level of perceived risk, necessitating careful inquiry for application.[78] As a System I process, affect and emotion are relatively understudied in intervention research, compared to many cognition based health behavior theory models. Tversky and Kahneman noted that cognitive processes are biased due to the distorting effects of recent experience, memory limitations, as well as other forms of biases.[77] In the case of chronic disease prevention behaviors, the cognitive model often

falls short, as adopting healthy lifestyle behaviors has proven challenging in self-regulation for many individuals despite the desire and commitment to do so.[49, 86]

Speaking to the interactional nature of the two systems, some researchers suggest investigation into how the "volitional process in System 2 can be used to inhibit the strong pragmatic tendencies to response in inference and judgment that come from System 1, especially where the latter are known to result in cognitive biases."[87] A large and rich debate exists in the literature surrounding relative roles of cognition and emotion; what remains clear is that the heuristics and cognitive biases of System I derive from a long evolutionary history that may pose challenging for humans to overcome. Rather than attempting to exert control over System I, it may be worth capitalizing on the affective factors as teachable moments for health behavior change. Indeed, emotional transitions are conceptually integral to the creation of teachable moments, and draw upon System I processing. For behavior change interventions, Marteau draws on Kahneman's work to suggest targeting automatic associative processes to make desired behaviors easier.[69] Possible communicative strategies targeting automatic processes are to *activate existing associations* through priming, the presentation of stimuli that activates or inhibits an associated mental concept or goal, or *altering existing or creating new associations* by manipulating the presentation of health information to increase positive associations with desired behaviors and/or increase negative associations with less healthy behaviors.[69, 88] At the individual level these strategies may be integrated with periodic prompts and reminders, aids for habit formation likely necessary for sustaining repeated behaviors.[89] Marteau recommends the application of targeting automatic associations in environmental interventions for greater population-wide effects, yet individual level interventions easily translate and may be similarly responsive. Taken together, an integration of environmental

and individual level approaches using automatic processes may potentially yield the greatest effectiveness for obesity prevention.[90]

Of note, the two systems of behavior are not truly distinct; rather, any exhibited behavior arises from a complex interaction and overlap of the two systems, a result of both intuitive and deliberative processes.[69] The rationale for highlighting the intuitive, automatic System 1 is to urge critical inquiry into the powerful role of affect and emotion in human behavior that has been relatively under-examined in behavioral interventions. The persistent challenge of obesity prevention signals the need for novel strategies that draw upon emotional salience to facilitate teachable moments while effectively communicating risk through System I processes. Improving understanding of the mechanisms of Systems I and II will facilitate clinical counseling to capitalize on both processes.[50, 91]

D.5 Theoretical Integration

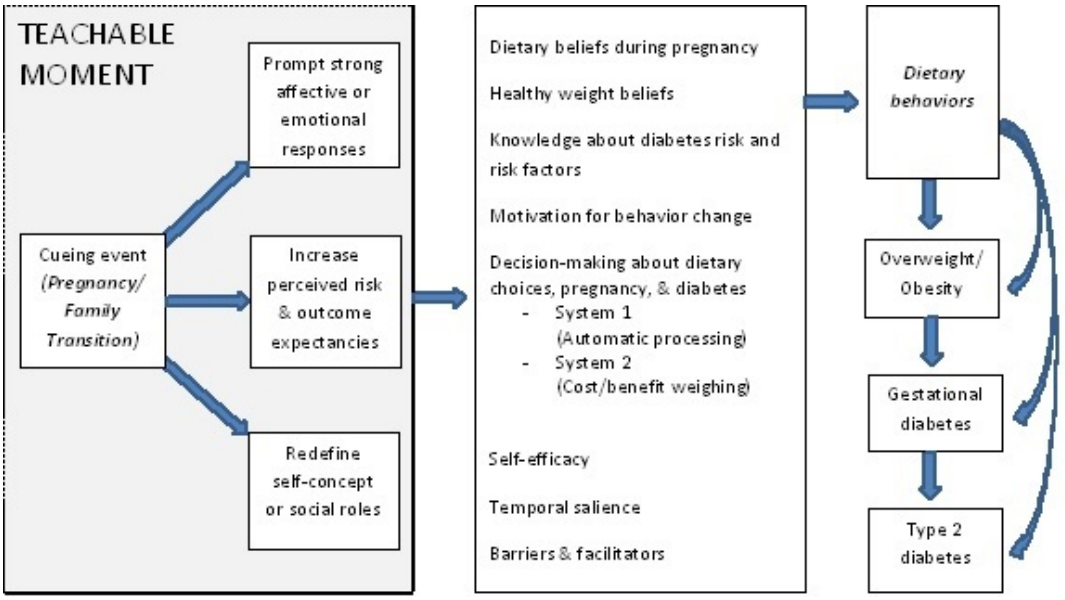
I integrated these concepts in my dissertation research, particularly exploring emotional responses in decision-making that may enhance the potential of pregnancy as a teachable moment for healthy dietary changes and for long-term diabetes prevention. The relevance of the three domains of a teachable moment to the research is described below and represented in Figure 2.

(1) Increase perceptions of personal risk and outcome expectancies. Affective System 1 strategies may be integrated with traditional analytical risk communication using appropriate health literacy modalities. Outcome expectancies may link GDM during pregnancy with long-term T2DM, and also focus on social roles or child outcomes.

(2) Prompt strong affective or emotional responses. An emotional event such as pregnancy is a powerful cue for triggering the adoption of risk-reducing behaviors.

The study explored concern for health of mother and baby, affective or positive and negative feelings around pregnancy, as well as other emotional areas surrounding pregnancy, diabetes, and the life course.

(3) Redefine self-concept or social roles. Given that familism is a core cultural value of Latinos, partners and the families of pregnant women may heighten motivational influence for the recommended behavior changes based on the importance of social roles. The transition to becoming a mother and family formation may also impact self-concept and facilitate engagement in healthy behaviors.



Adapted from Phelan; McBride et al. [34, 55]

Figure 2: Conceptual Model for Pregnancy as a Teachable Moment for Dietary Change and Diabetes Prevention

Figure 2 above shows the cueing event, pregnancy, and the three domains it impacts in constructing a teachable moment. The judgments and decision-making that ensue reflect the heightened contextual salience of perceived risk, affective and emotional responses, and self-concept that factors in to psychosocial valuation. In turn, psychosocial factors such as dietary beliefs during pregnancy, healthy weight beliefs, knowledge about diabetes risk and

risk factors, motivation for behavior change, dual processing of decision-making, self-efficacy, temporal salience, and associated barriers and facilitators lead to health behaviors such as diet and food choices. These behaviors contribute to medical outcomes such as weight gain, overweight or obesity, gestational diabetes, and later Type 2 diabetes.

A principal element of risk perception, the temporal salience of an event, typically places chronic disease prevention at a disadvantage in the System 2 weighing of short- vs. long-term costs and benefits. This population of pregnant women, however, is also at high risk for a near-term complication that emotionally affects themselves, their babies, and their families. As such, emotion also bears near-term value that may be capitalized on through targeting automatic processing. For instance, affective framing of positive health changes for mother and child during an emotional period (i.e., love for unborn child, creation of a healthy family food environment through redefinement of social roles) may heighten engagement with desired behaviors through an interaction between valuation of the behavior and the emotional response. Temporal salience may also be increased through a focus on a multitude of health outcomes – the risk of developing GDM in the near term with its associated pregnancy complications, and the seven-fold higher risk of developing Type 2 diabetes in the future.

Given the favorable context generated by the teachable moment for chronic disease counseling, I sought in this dissertation study to identify effective means by which healthy dietary behaviors may be fostered for diabetes risk reduction.

E. SPECIFIC AIMS

The overall objective of the dissertation was to identify innovative health communication messages and strategies for healthy lifestyle change informed by pregnancy as a teachable moment. The primary audience consisted of low income pregnant Central American immigrants at high risk for GDM and future diabetes in the Washington, D.C. metropolitan area.

The dissertation study has the following three specific aims:

1. **To examine risk factors for gestational diabetes among pregnant Latina women seeking prenatal care at Mary's Center over four years (2008-2012).**
    - I examined the association of total gestational weight gain with GDM incidence among pregnant Latina women.
    - I examined the association of 2nd trimester total and rate of gestational weight gain with GDM incidence among pregnant Latina women.

2. **To investigate the potential of pregnancy as a teachable moment for dietary change and diabetes prevention among CAI women and their health care providers at Mary's Center.**
    - I explored how Central American immigrant (CAI) women learn, given that effective teaching hinges on the dynamics of learning.
    - I constructed case studies of CAI women and health care providers at Mary's Center using in-depth interviews and chart reviews to explore differential trajectories of women at risk for GDM who either do or do not develop it.

3. **To identify health communication messages and strategies for gestational diabetes prevention for community-based organizations serving Central American immigrants.**
    - I explored the concordance of perspectives among Central American immigrant (CAI) women and their health providers to inform counseling around gestational diabetes to facilitate culturally competent care.
    - I identified health communication messages and strategies around pregnancy as a teachable moment that may aid healthy eating during pregnancy and over the life course to prevent diabetes and diet-related chronic illness.

F. RESEARCH DESIGN AND METHODS

F.1 Study Design

F.1.1 Mixed Methods Research

I used a mixed methods multiple case study design to investigate healthy dietary change and teachable moments during pregnancy for pregnant low-income Central Americans at Mary's Center clinic in the DC metro area. Mixed methods research is a "class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study(17)."[92] I describe the research design below.

The quantitative aim of secondary analysis of electronic health records informed the interviews and chart reviews of the second aim in an *explanatory sequential multiphase* (quan → QUAL → qual) mixed methods design. As explanatory indicates, the qualitative strand explained findings and provided in-depth detail regarding the results of the quantitative analysis. Secondly, as a *participant selection variant* of an explanatory design, I selected the individual cases in Aim 2 based partly upon the identification of predictors and covariates from Aim 1 (e.g., pre-pregnancy BMI, parity) and thematically matched between the GDM and non-GDM groups. Second, the case study design of the second aim integrated multiple qualitative sources of data to facilitate richer contextual analysis of the selected cases. The case study was embedded in the larger, mixed methods study; such case study designs inherently represent a form of mixed methods research(66).[93] The multiphase nature reflected the overall goal of the research to inform program development and generation of health communication strategies, which often occur in sequential and concurrent stages. In this dissertation study, I qualitatively developed recommendations and implications based on findings from the mixed methods strands. In future stages, a

quantitative testing or evaluation of these strategies would be valuable as formative research for a larger health communication intervention.

The mixed methods study design had the following points of interface, or stages of integration where strands mix:

Design stage: The overall objective to improve health communication around GDM guided the integration of multiple studies from the outset. The community clinic's need for GDM prevention research to improve care of prenatal women constituted program objective framework-based mixing. In addition, theoretical framework-based mixing occurred with the theoretical investigation of pregnancy as a teachable moment for life course diabetes prevention and guided the qualitative case study as well as the quantitative analysis (e.g., prior GDM history).

***Data collection*:** First, the explanatory sequential design guided the sampling of the qualitative strand. In the quantitative analysis I examined risk factors of GDM; in the subsequent qualitative sampling I chose critical cases and maximum variation sampling to inform participant selection and themes to investigate.

Data analysis: In the cross-case analysis I integrated results of the quantitative strands with the interviews and chart reviews. For instance, in the Aim 1 investigation of weight gain during pregnancy as a predictor of GDM, I quantitatively examined trimester specific weight gain while alongside that, I qualitatively explored changes in dietary patterns at transitional points during the gestational period to generate possible explanations for observed trends. Emergent findings may also prompt new questions, develop new hypotheses to test, or relate new variables within the quantitative analysis that could be examined in the multiphase study.

Interpretation: As with all mixed method designs, integration also occurred at the stage of interpretation to aid with answering the overarching research questions.

A strength of mixed methods research is to facilitate the study of more complicated research questions and "to collect a richer and stronger array of evidence than can be accomplished by any single method alone (66)."[93] The mixed methods approach for this dissertation study drew upon the same research question of understanding diabetes prevention and health communication strategies for Central American immigrants; each stage collected complementary data. The basis for using mixed methods for this study thereby lay with the following research objectives: *Development*: using results from one method to inform another method; *Initiation*: seeking paradoxes, contradictions, new perspectives and questions; and *Expansion*: extending the breadth and range of inquiry by engaging with different methods for different components of inquiry.

F.1.2 Multiple Case Study Design

I employed a case study design for Aim 2 of the dissertation study; I began by constructing individual cases and then conducted a cross-case analysis. I created two subgroups for the individual cases: 1) Pregnant Central Americans at risk for GDM who then developed it; 2) Pregnant Central Americans at risk for GDM who did not develop GDM. The rationale for a multiple case study design arose from my differing hypotheses based on the types of conditions (in this case, whether women had GDM or not) and my interest in having subgroups of cases covering each type.[93] In this dissertation research, the case study design allowed me to explore women's dietary behaviors and treatment trajectories over the gestational period, and to elicit perspectives from subgroups at differing levels of risk for GDM or T2DM (many were at risk for both conditions; however, women's risk perceptions for future T2DM could differ in severity according to whether or not they received a GDM

diagnosis). Given that the majority of pregnant women have at least one risk factor for GDM, developing tailored behavior change strategies can more effectively target groups at higher and lower risk.

The final sample consisted of 10 cases in each subgroup; 10 GDM and 10 non-GDM women. The selection of multiple cases allowed me to qualitatively explore variation among cases. I conducted purposive sampling based on critical case and maximum variation, and matched participants between sub-samples for a diversity of characteristics (i.e., age range, parity, family history, risk factors) which allowed for richer exploration of relevant themes.

Moreover, case study research allows for examination of exemplary outcomes, provided the outcome is known, with the "multiple case inquiry focusing on how and why the exemplary outcomes may have occurred and hoping for literal (or direct) replications of these conditions from case to case(62)."[93] In the dissertation study, the two aggregate cases had distinct outcomes – development of GDM and no development of GDM. The multiple case design allowed me to investigate how these groups differed in their pregnancy and postpartum experiences, which included dietary patterns, perceptions of risk, barriers and facilitators, provider counseling, and affective or emotional responses. The integration of the case study into the overall mixed methods study allowed me to conduct a deeper exploration of factors that could influence healthy eating and diabetes prevention based on multiple levels of inquiry.

F.2 Community Description

F.2.1 Study Population

The overall study population consisted of Central American immigrant women accessing prenatal services at the Mary's Center clinic. The secondary population included health care providers of the primary study population such as midwives, health educators,

nutritionists, and ob/gyn doctors. Participant triangulation enabled us to draw upon multiple perspectives to inform health communication strategies based on social influences and the role of providers.

F.2.2 Setting

The dissertation research was conducted at Mary's Center for Maternal and Child Care, which serves a large number of low-income Central American participants facing high rates of obesity and GDM.

Community partner: Mary's Center for Maternal and Child Care (MC), a Federally Qualified Health Center (FQHC) since 2005 in the Maryland and Washington D.C. metro area, sees patients regardless of their ability to pay. Founded in 1988, MC provides health care, family literacy and social services to 24,000 individuals whose needs too often go unmet by the public and private systems. MC maternal and child health services provides care to approximately 1,300 pregnant patients yearly. Approximately 75% of patients are Salvadorans and Guatemalans; half are obese and experience high rates of GDM.

The collaborating investigators were involved in development of study aims and methods, and establishing terms of the academic--community partnership. Collaborators aided with supervision of recruitment, coordinated interviews spaces, and participated in all stages of research from formulation of research questions to preparation of manuscripts.

Aim 2 Qualitative Research Questions

Pregnancy as a teachable moment

RQ 1: To what extent can pregnancy be a teachable moment for dietary change over the life course?

RQ 2: How do pregnant women construe the domains of a teachable moment (i.e., social roles and self-concept, emotional and affective factors, risk perceptions and

outcome expectations) and how do these interact with dietary change and diabetes prevention?

Dietary behavior

RQ 3: What are typical food patterns and dietary behaviors for Central American immigrants and how, if at all, has diet changed during pregnancy or over time?

RQ 4: What are barriers and facilitators to healthy eating for this group?

Dietary decision-making

RQ 5: How do intuitive and deliberative processes interact to produce dietary decisions?

What factors impact dietary choices (e.g., culture, taste, health) and what are their relative influences?

RQ 6: What communicative strategies by providers, friends, or family are desirable or influential for dietary change?

Diabetes salience

RQ 7: What is the ethnomedical view of diabetes for Central American immigrants?

RQ 8: How does perceived risk of diabetes during pregnancy compare with lifetime risk?

How does the temporal salience of diabetes differ in the immediate, near-, and long-term?

RQ 9: What are emotional or informational triggers that would prompt diabetes prevention behaviors?

Higher vs. lower risk groups

RQ 10: What differentiates women with a GDM diagnosis from women without a GDM diagnosis on RQs 1-9?

F.3 Data Analysis

I describe the qualitative data analysis in this section to provide additional detail on data collection and analytic procedures described in Manuscripts 2 and 3. The quantitative data analysis is described within Manuscript 1 (see Section G, pp. 34).

Each qualitative interview was audio-recorded and transcribed verbatim. I transcribed the provider interviews which I conducted in English. Native Spanish speakers transcribed verbatim the interviews with Central American women that I had conducted in Spanish. I then reviewed each transcript to ensure accuracy and enhance the familiarization process.

I analyzed the qualitative data guided by the potential for pregnancy as a teachable moment for behavior change, while taking into consideration barriers and facilitators at the individual, cultural, social, and environmental level.

***Framework Analysis*:** I employed framework analysis to analyze the qualitative data. Framework analysis, developed by the Social and Community Planning Research Institute, is often used in the context of conducting applied qualitative research, namely for policy or programmatic purposes.[94] It is flexible for application across different types of studies including case studies and in-depth interviewing. In this study, I used framework analysis to

synthesize and interpret the qualitative data. The selection of framework is based on its fitting integration with qualitative data to facilitate systematic analysis of multiple perspectives, to aggregate data from a variety of methods, and to explore cross-case patterns.

I applied the following five key stages of framework analysis as described by Ritchie and Spencer:[94]

1. *Familiarization*- Immerse in the collected data in its entirety such as re-reading transcripts, analyzing charts, and memos to enhance an overview of the rich and diverse data
2. *Identifying a thematic framework*- Set up a thematic framework using the key issues, concepts, and themes identified through familiarization
3. *Indexing*- Systematically apply the thematic framework to the textual data (i.e., code)
4. *Charting*- Lift the data from their original context and rearrange them according to the desired thematic reference to construct a picture (e.g., charts or matrices)
5. *Mapping and interpretation*- Map and interpret the data as a whole by applying inductive thinking to draw meaning, salience, and connections from the data

These stages provided a systematic framework to organize and manage data; the analytic process, however, was iterative, which at times meant jumping ahead or returning to earlier ideas following conceptual development. While guided by the stages of framework, I analyzed the data reflecting the emergent process. In addition, a useful feature of framework is its explicit documentation of methods and analytic techniques, which facilitates information sharing and transparency among researchers. The stages of analysis

and accessibility also supported collaborative interpretation with the community clinic. During charting and mapping, I consulted with community partner researchers in order to obtain feedback and draw on additional insights. I engaged in member checking with key providers and collaborators at Mary's Center to share and obtain feedback on preliminary findings to enhance the accuracy and depth of the analysis.

I engaged in memo writing throughout the data collection and analytic process to capture emergent themes, explore their relationships, and note areas of investigation to follow up on. In addition, after each participant interview I reflected on the interview and wrote a memo on the following categories: Description of Participant, How Interview Went, Reflexivity (my role in the interview), Emerging or Notable Themes, and I Wish I had Asked. I referred to these memos to inform themes to explore in the following interviews, in postpartum interviews with the same women, and also used them as records in the data analysis. Memos as a procedural and analytical strategy "add to the credibility and trustworthiness of qualitative research and provide a record of the meanings derived from the data.[95, 96]"

I used Atlas.ti v.6.1, qualitative project software (Berlin, Scientific Software Development), to manage, code, and assist with analysis of the qualitative data (i.e., in-depth interviews, chart reviews, memos).

I developed the codebook both inductively and deductively. I began inductively by coding two transcripts (one GDM and one non-GDM) line-by-line to develop codes. I then deductively applied codes from my theoretical framework and research questions, and organized them into thematic codes. I reapplied the codebook with thematic codes to the two interviews, and a research assistant coded the same two interviews using the codebook We each coded two transcripts line-by-line, then discussed the codebook to achieve consensus. We clarified codes and I refined the codebook based on these discussions. While

developing the codebook, I also discussed the thematic framework and codes with fellow collaborators and researchers, in order to refine ideas. I used the same codebook to code all interview transcripts, for providers and Central American women. I conducted the analysis in Spanish to retain the meaning, context, and idiomatic expressions of the informant. I met weekly or biweekly with the bilingual native Spanish speaking research assistant throughout the coding to ensure accurate interpretations of the data, particularly of linguistic expressions and cultural nuances. The research assistant reviewed the selected quotes I translated from Spanish to English to ensure accuracy for inclusion in the manuscript.

I met regularly with the community clinic collaborators to discuss emerging findings, research progress, and plans for dissemination. I have written up the research findings for publication with community collaborators and research mentors as co-authors. I am presenting the research and findings to the medical team at the monthly provider meeting at Mary's Center. The meeting will provide the opportunity for collaborative discussion of results and implications for clinical care and further research.

G. MANUSCRIPT 1

TITLE: Greater gestational weight gain increases risk of gestational diabetes among low-income Central American immigrants in Washington, D.C.

BACKGROUND:

Burden of GDM

Gestational diabetes mellitus (GDM) is an increasing problem worldwide and the most common pregnancy complication.[97] GDM prevalence as traditionally defined is approximately 7% in the United States and ranges depending on the population characteristics and screening practices.[3] Under new diagnostic criteria recommended by the International Association of Diabetes and Pregnancy Study Group (IADPSG), 18% of pregnancies are affected by GDM.[1, 2] The rise in prevalence of GDM necessitates greater research to prevent adverse long-term consequences for mothers and their children.

GDM is traditionally defined as the onset or first recognition of abnormal glucose tolerance during pregnancy.[2] GDM results from a reduced ability of the pancreas to produce sufficient insulin during the insulin-resistance induced by pregnancy, resulting in hyperglycemia.[4] GDM is associated with both maternal and fetal complications, including large babies, cesarean delivery, preeclampsia, perinatal morbidity, childhood obesity, and a seven-fold increased maternal risk of later Type 2 diabetes.[3-4, 6-9, 18] GDM typically manifests

[2] Due to increasing rates of overt but unrecognized Type 2 diabetes in young women and lack of routine glucose testing in this age group, the proposed new definition of diabetes diagnosed during pregnancy distinguishes *overt diabetes* (pre-gestational diabetes) from *gestational diabetes mellitus* (developed during pregnancy). The prevalence of GDM depends on the definition used; IADPSG and the American Diabetes Association (ADA) recommend the new definition while the American College of Obstetricians and Gynecologists (ACOG) maintains the traditional definition, which is inclusive of both types.

around 24-28 weeks gestation as a result of physiologic changes in pregnancy exacerbated by pre-existing risk factors such as obesity or pre-diabetes.[5] Other risk factors include family history of diabetes, excess gestational weight gain (GWG), poor diet, low physical activity, and being of a racial/ethnic minority group in the US.[1] With the rise of obesity, the incidence of GDM has correspondingly increased and is likely to pose a substantial public health burden.[3]

Link of gestational weight gain (GWG) and GDM

Appropriate weight gain during pregnancy is an important aspect of prenatal counseling in order to prevent adverse maternal and child outcomes. Nearly half of women in the United States begin pregnancy overweight or obese while greater than half of overweight and obese women then experience excessive gestational weight gain.[22] Higher pre-pregnancy weight (and BMI) has been well-established in the literature for its association with greater risk of GDM.[22] Excess gestational weight gain (GWG) is also associated with GDM, though more tenuously. The few studies conducted that examine gestational weight gain as it relates to GDM during pregnancy have generated inconsistent links, potentially due to the wide range of populations. Hedderson and colleagues found that increased weight gain in the first trimester primarily accounted for the association between rate of gestational weight gain and GDM, with a stronger association in overweight/obese and non-white women.[23] A later meta-analysis found excessive gestational weight gain to be predictive of GDM, with no evidence of differential risk by pre-pregnancy BMI category.[24] The evidence has been mixed for effects of reduced gestational weight gain - or even of weight loss- on the risk of maternal and neonatal morbidities for obese women with GDM.[25, 26] Few studies, moreover, have examined the association of gestational weight gain with GDM among low-income Latinas, who face greater risk of developing GDM compared to non-Latina whites.[1, 14, 23]

A revised Institute of Medicine (IOM) report released in 2009 provided recommendations for total and rate of gestational weight gain specific to the pre-pregnancy weight status of women.[27] The IOM report itself, and an Agency for Health Quality Research (AHRQ) systematic review, documented a lack of quality data on gestational weight gain during pregnancy to firmly relate it to GDM in pregnancy.[22, 28] Most of the reviewed studies in the IOM report, however, focused on total weight gain over the entire pregnancy, which includes weight gained after GDM is diagnosed at the end of the second trimester.[22, 24] Research is called for that addresses gaps in the literature to better establish optimal weight gain recommendations.[29]

High priority research needs for GDM

In addition, GDM increases later risk of diabetes, with an estimated 17-63% of mothers who had GDM developing type 2 diabetes mellitus (DM) in the next 5-16 years after the index pregnancy.[7] The high risk period during and after pregnancy, during which lifestyle interventions and behavior modification such as diet and exercise are needed, plays a critical role in prevention of diabetes.[8] Indeed, a synthesis of GDM research needs identified risk factors, prevention, and screening for diabetes in women with prior GDM as high priority for future diabetes research.[10] Systematic reviews of GDM recurrence in future pregnancies found that recurrence rates were high, between 52-69%, with higher rates found in minority populations.[98, 99] Studies also cite greater need for research on racial, ethnic, and socioeconomic diverse populations.[39]

Low-income Latinas with GDM

Few studies have examined gestational weight gain and GDM within primarily Latina populations. Multiethnic studies have been conducted but with relatively low representation from the largest ethnic minority group in the United States. The paucity of

Latina-specific studies for GDM limits understanding of cultural or genetic factors that may interplay with behavioral risk factors.[100] For instance, foreign born Mexican women were found to have higher rates of GDM compared to women born in the United States, underscoring the potential contributory role of culture or behavior.[101] Notably, no known studies to date have examined GDM among Central Americans in the United States. More research is needed to address health needs of Latina immigrants who suffer disproportionately from GDM while underutilizing prenatal care.[102]

The prevalence reflects national population statistics reported by the Centers for Disease Control, with Latinos in the United States almost twice as likely as non-Hispanic Whites to be diagnosed with diabetes.[103] Public health research for Latinos is critical in order to develop effective interventions to reduce racial and ethnic disparities in health.[104]

Latino subgroups make up culturally distinct populations and are represented differentially in the literature, with Mexican Americans, Puerto-Ricans, and Cubans comprising the majority of studies, with few involving Central Americans.[105, 106] Culturally appropriate interventions need to account for sociopolitical, economic, and health differences among Latino immigrant groups, since prevalence and risk factors for diabetes differ among subgroups.[100, 107] To address health disparities for Latinos, differentiation among Latino groups is increasingly necessary to identify culturally specific risk factors, barriers, and facilitators to inform interventions.[100]

Present study

This study aims to further the research on gestational weight gain as it relates to GDM, and to expand the research on ethnic minority and low socioeconomic populations. This quantitative analysis served as the first part of formative work under a mixed-methods approach to inform health communication strategies for healthy eating among pregnant

Latina women to prevent GDM incidence and later Type 2 diabetes. We investigated dietary changes during pregnancy through qualitative interviews and chart reviews to identify transitional points that could influence diet and weight gain. Qualitative interviews with pregnant women revealed changes in eating behavior after the typically severe morning sickness of the first trimester, which often entailed consuming larger quantities of foods (e.g., often following the myth of "eating for two"). These changes in dietary patterns could conceivably lead to rapid increases in weight gain and potentially increase the risk of developing GDM. We thereby conduct the present quantitative analysis of the same population to examine association of weight gain with GDM incidence to inform teachable moments for counseling during pregnancy.

This study fills research gaps identified by the IOM report to examine adverse maternal and child outcomes that arise from gestational weight gain, namely GDM. Few studies to date have examined the association of gestational weight gain with GDM incidence. This is also the first study to examine gestational weight gain as a predictor of GDM in a low income Hispanic/Latina population of primarily Central American immigrants. These have clinical implications for weight gain recommendations during pregnancy to guide healthy weight gain and potentially prevent GDM.

In this study, we conduct a retrospective cohort study to examine risk factors for gestational diabetes in a population of Latina women accessing prenatal care at Mary's Center over four years (2008-2012).

Objective 1: To examine the association of total gestational weight gain with GDM incidence among pregnant Latina women.

Hypothesis 1: Total gestational weight gain is positively associated with GDM incidence.

Objective 2: To examine the association of 2nd trimester total and rate of gestational weight gain with GDM incidence among pregnant Latina women.

Hypothesis 2: Total and rate of gestational weight gain in the 2nd trimester is positively associated with GDM incidence.

METHODS:

Study design

We conducted a retrospective cohort analysis using electronic medical records from a single FQHC in Washington, DC of Latina women (≥15 years old) accessing prenatal care over a four year period with oral glucose tolerance test (OGTT) results. This study was approved by the human subjects committee of the Johns Hopkins Bloomberg School of Public Health.

Setting

Mary's Center for Maternal and Child Care is a large, Federally Qualified Health Center (FQHC) that provides health care, family literacy and social services to individuals whose needs too often go unmet by the public and private systems.[108] Serving over 2000 expecting mothers in 2014, Mary's Center provides access to health care services regardless of participants' ability to pay.

The Washington D.C. metropolitan area has the third-largest concentration of Central American immigrants in the United States at approximately 264,000 individuals, accounting for 4.6% of the metro area population.[109]

Participants

The population under study consisted of Latina women accessing prenatal services at multiple Mary's Center sites in the Washington, D.C. metropolitan area. The analysis conducted in this paper focused on a subset of the women seen for prenatal care across all Mary's Center sites that had oral glucose tolerance test (OGTT) lab results (n=1285).

We drew the study population from the local health clinic of Mary's Center for Maternal and Child Care, a Federally Qualified Health Center (FQHC) in Washington, D.C. that serves over 30,000 medical participants regardless of their ability to pay. The participant base is primarily comprised of underserved minorities; 76% are Latinos and largely from the Central American countries El Salvador, Guatemala, and Honduras. Clinic estimates show that half of the Mary's Center participant base is obese, and at high risk for obesity-related comorbidities such as cardiovascular disease and diabetes.

Sample selection

Inclusion criteria comprise women who self-identified as Hispanic/Latina, ages 15 years and older, who accessed prenatal services at Mary's Center for a pregnancy beginning from June 1, 2008- December 31, 2012, who had oral glucose tolerance test lab results, a self-reported pre-pregnancy weight, and positive weight gain to 29 weeks gestation (at OGTT lab testing). Exclusion criteria included non-Latina women, non-pregnant women, pregnancies not beginning in the four year time duration, not having an OGTT lab test used to classify GDM diagnosis, no self-reported pre-pregnancy weight, and zero or negative weight gain to 29 weeks gestation (at OGTT lab testing) (see Figure 1 for STROBE flowchart of inclusion/exclusion).

We constructed the GDM diagnoses based on oral glucose tolerance test lab results, necessitating its inclusion. Self-reported pre-pregnancy weight is needed to calculate the main exposure of total gestational weight gain. Entries producing negative weight gain over

the 1st and 2nd trimester, or over the 2nd trimester of pregnancy alone, were excluded from the analyses to enhance accuracy of the weight gain measure by excluding potential errors in clinical recording or measurement.

Data source

The initial dataset included all pregnancies in the date range during June 1, 2008 through December 31, 2012 (n=5553). The analytic dataset included only the latest pregnancy for women who had results for the oral glucose tolerance test, a self-reported pre-pregnancy weight, and positive weight gain to 29 weeks gestation (at OGTT lab testing) (n=469).[3]

Definition of main exposure: total gestational weight gain

We constructed two total gestational weight gain (GWG) variables; 1st-2nd trimester weight gain (n=455) and 2nd trimester weight gain only (n=250). For both GWG variables, we identify the end weight as the last clinic visit weight for each woman prior to OGTT lab testing, if the weight was taken between 26-29 weeks gestation. The GDM lab testing date marks the OGTT diagnostic test after failure of the initial screening test; the two tests were usually administered on different days. Since the Mary's Center clinic protocol specifies GDM screening for all pregnant women between 26-29 weeks, we used the last clinic weight prior to the OGTT testing as the end weight for 2nd trimester GWG. To assess total GWG over the 1st and 2nd trimester, self-reported pre-pregnancy weight was used as the beginning weight. To assess 2nd trimester GWG, the earliest clinic weight taken between 14-16 weeks was used as the beginning weight.

[3] Women in the subsample (with OGTT lab data) had significantly higher pre-pregnancy BMI compared to the main sample. However, women in the subsample did not differ from the main sample in gestational weight gain, enabling subsample analysis for the GWG predictor. Women without the OGTT were also similar to women included in the analysis on age and parity.

Definition of rate of gestational weight gain

We calculated the rate of gestational weight gain (in pounds per week) over the 2nd trimester only, using available clinic weights before the OGTT test. The rate of gestational weight gain was calculated as the last clinic visit weight prior to OGTT lab testing, if the weight was taken between 26-29 weeks gestation, minus the first weight taken between 14-16 weeks (beginning of 2nd trimester). The weight gain numerator was then divided by the weeks of gestation for the last weight minus the weeks of gestation for the first weight, to obtain rate of weight gain.

We categorized women as meeting or exceeding the 2009 IOM recommendations for rate of weight gain in the 2nd trimester, based on pre-pregnancy BMI. The number of weeks of gestation used in the calculation for rate of weight gain in the 2nd trimester was multiplied by the rate of recommended weight gain (in lbs/wk) for each BMI category (normal: 1; overweight 0.6, obese 0.5). Women were grouped into two categories as either having met (i.e., below or met combined) or exceeding weight recommendations based on their actual weight gained during the 2nd trimester.

Definition of outcome

GDM screening conducted at the Mary's Center clinic followed the ADA 2000 screening guidelines.[110] All pregnant women were screened with the GCT around 26-28 weeks. Laboratory measures used two-step testing to diagnose GDM, starting with the *screening* 50-g, 1-hour glucose challenge test (GCT), followed by the *diagnostic* 100-g, 3-hour plasma oral glucose tolerance test (OGTT) for those who screened positive on the GCT. GDM testing was typically conducted at 26-28 weeks gestation. The 3-hr OGTT was administered fasting only to women who screened positive on the 1-hr GCT (>140 (mg/dl). Women were classified as having GDM if obtaining two or more abnormal values on the

plasma oral glucose tolerance test (OGTT), per the American Diabetes Association 2003 criteria [fasting>95 (mg/dl), 1 hr>180, 2 hr>155, 3 hr>140].[110] Gestational weight gain was assessed up to the GDM diagnosis, using the last clinic weight prior to 29 weeks gestation and taken prior to the OGTT test. No covariates were included in the model that could manifest after assessment of the GDM outcome (e.g., preeclampsia, family history).

Definitions of co-variates

Available variables recorded in clinic charts included age, entry to prenatal care, laboratory measures for GDM, clinical measures (i.e., blood pressure), anthropometric measures (i.e., weight and height), pregnancy characteristics (i.e., parity), and socio-demographic measures (i.e., federal poverty level and type of insurance coverage).

After Mary's Center transitioned to electronic clinical records in 2008, providers electronically recorded pregnancy related variables and clinical indicators at each clinic visit over the four years of this study (2008-2012). Weight and blood pressure were recorded at each clinic visit.

Anthropometric data, height and weight, were directly measured by medical assistants in the clinic and recorded in the electronic clinical record. Medical assistants also obtained self-reported pre-pregnancy weight from pregnant women at the first prenatal visit. We calculated pre-pregnancy body mass index (BMI) from self-reported pre-pregnancy weight (pounds) and height (inches) as measured in the clinic. Pre-pregnancy BMI was categorized and grouped into the following three weight categories: underweight/normal (BMI: <25 kg/m^2)), overweight (BMI: 25-29.9 kg/m^2), and obese (BMI: ≥30 kg/m^2). Underweight and normal categories of pre-pregnancy BMI category were combined into one category for analysis, given the small numbers of underweight women (n=7, 0.7%).

Several covariates of interest were obtained from the clinic charts. Blood pressure at the first prenatal visit was categorized into normal, prehypertension, and hypertension according to 2006 guidelines from the American Heart Association.[111] Entry to prenatal care comprised gestational weeks at a woman's first prenatal care visit. Parity, the number of prior pregnancies women carried to a viable age, was reported in charts and ranged from 1 to 3 during the time period from 2008-2012. Age and parity as covariates of interest were included in the analyses.

Statistical methods

We created bivariate and multivariable logistic regression models to assess the association between total gestational weight gain and GDM incidence among pregnant women. In multivariable models examining total weight gain up to GDM screening (i.e., over the 1st and 2nd trimesters), we adjusted for age, pre-pregnancy BMI (continuous), and parity. In models for the outcome of total weight gain and rate of weight gain during the 2nd trimester we adjusted for age, BMI at beginning of 2nd trimester, and parity.

We additionally created multivariate linear regression models examining the association of total weight gain with GDM stratified by pre-pregnancy BMI category. In these multivariable models for the outcome of total weight gain up to GDM screening, total weight gain in the 2nd trimester, and rate of weight gain in 2nd trimester, we adjusted for age, pre-pregnancy BMI category, and parity. These analyses of weight gain by normal, overweight, and obese BMI categories pre-pregnancy correspondingly controlled for pre-pregnancy BMI category rather than beginning of 2nd trimester BMI. To characterize whether women met or exceeded the IOM recommendations by pre-pregnancy BMI category, we adjusted for age, pre-pregnancy BMI category, and parity.

We generated interaction terms for 1) BMI and total weight gain up to the GDM screening, 2) BMI and total weight gain over the 2nd trimester, and 3) BMI and rate of weight gain in the 2nd trimester.

The data was analyzed using STATA version 11.[112]

RESULTS:

Sample characteristics

Of the analytic sample (n=469), approximately 16% of the women met clinical criteria for a GDM diagnosis using the validated sample with OGTT results, reflecting population statistics of GDM prevalence in Latina pregnant women under the ADA screening criteria[110] (Table 1).

Age at the beginning of pregnancy did not differ significantly between groups ($p<0.44$).

Country of origin differed moderately between non-GDM and GDM women, with more GDM women originating from Central American countries of El Salvador, Guatemala, and Honduras compared to more non-GDM women originating from other countries or the United States ($p<=0.05$).

Higher pre-pregnancy BMI was associated with a greater risk of GDM (OR 1.07, 95% CI 1.02-1.13, $p<0.01$).

BMI at the beginning of the 2nd trimester did not differ significantly between groups ($p<0.10$). Parity did not differ significantly between groups ($p<0.88$). Blood pressure at first prenatal visit did not differ significantly between groups ($p<0.23$).

The median entry to prenatal care was 89 days [Range 35-203 days], at approximately 12.7 weeks gestation. The average time of entry to prenatal care did not differ between groups ($p<0.38$).

Association between total gestational weight gain and GDM incidence

Overall, after controlling for age at beginning of pregnancy, parity, and either pre-pregnancy BMI or BMI at the beginning of 2nd trimester, greater gestational weight gain was associated with an increased risk of incident gestational diabetes among pregnant Latina women (Table 2). The effect was stronger for obese women (Table 3).

Association between total weight gain over the 1st-2nd trimester and GDM incidence: In the adjusted models (multivariable logistic regression), women who had greater GWG across the 1st and 2nd trimesters had a significantly greater risk of developing GDM, controlling for pre-pregnancy BMI, age, and parity (OR 1.03, 95% CI 1.0-1.05, $p<0.029$) (Table 2). Each pound gained in the 1st and 2nd trimester was associated with a 3% increased likelihood of developing GDM. The effect was even stronger for obese women, who had twice the risk of developing GDM with greater weight gain across the 1st and 2nd trimester (OR 2.3, 95% CI 1.14-4.69, $p<0.02$) (Table 3).

The interaction of pre-pregnancy BMI category with total 1st-2nd trimester GWG was not significant.

Association between total weight gain in the 2nd trimester and GDM incidence: In the adjusted models, women experiencing greater GWG over the 2nd trimester increased the risk of developing GDM, controlling for BMI at the beginning of 2nd trimester, age, and parity (OR 1.07, 95% CI 1.0-1.14, $p<0.038$) (Table 2). For each pound of weight gained, there was a 7% increase in the risk of GDM.

Women with higher GWG over the 2nd trimester had increased risk of developing GDM, controlling for pre-pregnancy BMI categorical weight status (OR 1.1, 95% CI 1.04-1.2, p<0.002). Obese women who gained more weight across the 2nd trimester were at three times the risk of developing GDM (OR 3.3, 95% CI 1.18-9.5, p<0.02) (Table 3).

The interaction of pre-pregnancy BMI category with total 2nd trimester GWG was not significant.

***Association between rate of weight gain in the 2nd trimester and GDM incidence*:**

In the adjusted models, women with a higher rate of weight gain over the 2nd trimester had increased risk of developing GDM, after controlling for BMI at the beginning of the 2nd trimester, age, and parity (OR 2.4, 95% CI: 1.05-5.5, p<0.04) (Table 2). When controlling for pre-pregnancy BMI category, obese women were three times more likely to develop GDM for each unit increase of pound per week (OR 3.3, 95% CI: 1.16-9.2, p<0.03) (Table 3).

The interaction of pre-pregnancy BMI category with rate of 2nd trimester GWG was not significant.

DISCUSSION:

In this retrospective cohort study we showed a positive association between gestational weight gain and GDM incidence among a population of Latina women seeking prenatal care at a FQHC in Washington DC. Pregnant women who gained more weight leading up to second trimester GDM screening, and who had a higher rate of weight gain in the 2nd trimester, were at greatest risk of developing GDM. The effect of 2nd trimester weight gain was even stronger for women with pre-pregnancy obesity, whose risk of developing GDM with greater weight gain was nearly four times higher when compared to women with normal pre-pregnancy BMI.

Our results contribute to the knowledge of gestational weight gain as it relates to GDM in a population of low-income Latinas. The lack of prior studies for this population limited our understanding of how weight gain during pregnancy may vary for diverse groups. Many studies have similarly demonstrated that women with pre-pregnancy obesity are at greater risk of developing GDM.[97, 110] In this study, obese Latina women who gained more weight during pregnancy experienced four times the risk of GDM incidence, a significant effect that may suggest a greater need for clinical monitoring of weight gain among obese Latinas. More studies are needed to confirm and replicate these results among low-income Latina women, by pre-pregnancy weight status.

This study also contributes to the knowledge of trimester-specific weight gain, namely in the 2nd trimester. The few studies that have examined gestational weight gain in the first trimester and over the 2nd trimester have generated inconsistent findings. In this study, we found that greater 2nd trimester weight gain has a particularly strong association with GDM incidence, which bears important implications for clinical monitoring and lifestyle counseling for weight gain between 16-24 weeks gestation. Dietary patterns for many pregnant women often transition at this time, since 70-85% of pregnant women experience morning sickness early in pregnancy from hormonal changes.[113] As the qualitative interviews for this formative work revealed, many women begin to resume more regular eating patterns in the 2nd trimester as the severe nausea of early pregnancy begins to subside. Behavioral changes in the 2nd trimester may thereby impact weight gain as women regain appetite, which is often coupled with the myth of "eating for two" that many pregnant women hold. These physiological and behavioral factors may increase the tendency for women to eat larger quantities with the intention to nourish mother and baby.

These findings and other studies suggest that exceeding gestational weight gain during the second trimester may significantly increase risk of developing GDM. Importantly, this marks teachable moments at key points during the gestational period to provide nutritional and weight gain counseling particularly timed around potential transitions in eating behavior, notably once morning sickness subsides in severity and women resume more regular dietary patterns. Providers in their monitoring of gestational weight gain should take into account behavioral changes that correspond with physiological changes in pregnancy to deliver optimally timed counseling.

Moreover, given the far higher risk of GDM incidence among women who begin pregnancy obese, targeted behavioral counseling may be valuable for this group. More studies on 2nd trimester weight gain combined with dietary indices may provide a better understanding of the interaction between lifestyle behaviors and clinical outcomes during a critical period of pregnancy weight gain, to inform behavioral interventions.

In a case control study, Hedderson and colleagues found that gestational weight gain and GDM was primarily attributed to increased weight gain in the first trimester.[23] In this study, there was lack of sufficient data for us to examine first trimester weight gain due to later entry to prenatal care for much of this population (median entry to care was the beginning of the 2nd trimester). In this study, since higher rates of weight gain in the 2nd trimester were associated with greater risk of GDM, particularly for obese women, this may signify continued influential physiological changes and behaviors impacting GDM development. Further studies with large numbers of low income Latinas are needed in order to expand on and replicate trimester-specific understandings of weight gain effects.

The higher risk for obese women to develop GDM during pregnancy calls for greater attention to their transition to metabolic resistance. While all pregnant women experience a

degree of insulin resistance during pregnancy in order for the growing fetus to uptake energy (i.e., glucose from the bloodstream), some women with preexisting risk factors exacerbated by weight gain may pass a metabolic threshold to result in the development of GDM. Other studies have also found greater risk of GDM among obese women gaining excess gestational weight.[23] Latinos face twice the lifetime risk of diabetes compared to non-Latino whites, which may reflect genetic predisposition and physiological interactions.

Implications

Notably, the implications of pre-pregnancy weight extend beyond the index pregnancy, since overweight women are more vulnerable to gaining excess gestational weight and retaining pregnancy weight.[114] Over the life course, childbearing often impacts the weight status of women and may contribute to overweight or obesity.[114] Moreover, low income and ethnic minority women in the United States are most vulnerable to these changes in weight.[114] Culturally tailored health counseling and counseling on weight changes preconception, during pregnancy, and postpartum may help to reduce women's risk of obesity and associated metabolic consequences.[101, 115, 116] Of note, GDM during pregnancy is one manifestation of insulin resistance, which carries similar increased risk as impaired glucose metabolism (i.e., pre-diabetes) for transformation to later T2DM[97]. Studies have found that children of women experiencing excess gestational weight gain are at greater risk for overweight and obesity.[117] These life course and intergenerational effects of excess pregnancy weight gain underscore pregnancy as a pivotal time period to prevent longer term consequences for maternal and child health.

Formative research for interventions may explore prevention of obesity and diabetes for women and their families over the life course.[118] During gestation, fetal risk of macrosomia is reduced when GDM is controlled. Strikingly, studies have found that

children's risk of overweight and obesity is greater when mothers gain excess weight during pregnancy, carrying into the child's early childhood, teen, and adult years.[117, 119] A life course perspective for healthy weight and diabetes prevention may begin with a focus on weight gain during pregnancy. Further research may examine pregnancy as a teachable moment for healthy lifestyle modification to improve long-term health for the family, and identify transitional points during the gestational period where behavioral changes may correspond with weight gain trajectories.

Future studies with larger sample sizes and diverse populations may identify clinical cut-points for excess weight gain- at specific gestational timepoints- that increase the risk of GDM. These could inform and expand the 2009 IOM clinical recommendations for weight gain during pregnancy for specific populations. Since GDM manifests toward the end of 2nd trimester, developing specific guidelines up to and including the 2nd trimester may aid clinical counseling to prevent GDM, in part through weight gain thresholds specific to a woman's pre-pregnancy BMI category.

Prevention strategies informed by pregnancy as a teachable moment may delay the progression of GDM into pre-diabetes and T2DM by following women postpartum and into future pregnancies. Prospective cohort studies are needed to determine whether GDM resolved from follow-up postpartum blood glucose tests, whether GDM recurs in subsequent pregnancies, and what factors influence development of pre-diabetes or T2DM for gestational diabetics. Factors to examine may include postpartum weight retention, birth spacing, weight changes, and lifestyle behaviors including diet and physical activity. Future studies may also examine both risk and protective factors for GDM (e.g., potential influence of diet, family structure, social support, health promotion encounters). In addition,

mixed method studies for women whose GDM resolves and does not recur could enhance understanding of lifestyle or clinical factors that may contribute to diabetic risk reduction.

Limitations

Several limitations exist in this retrospective analysis. First, our study included a single clinical site and the generalizability of these findings to other Latina and even non-Latina women may be limited. Second, to enhance the accuracy of the GDM diagnosis, we analyzed the subsample of women with the oral glucose tolerance test (OGTT) results only. This greatly reduced our sample size to 23.1% of the main sample, reducing both the power and potentially the generalizability of the findings. The lab-based sample may also introduce potential bias with regard to potential inclusion of those at a higher risk of GDM, since those taking the OGTT had failed the initial screening test in the two-level screening process. Despite these limitations, comparisons of the subset with the initial sample did not result in statistically significant differences in gestational weight gain, enabling statistical comparison of GWG in the resulting analyses. Moreover, the proportion of those with GDM in the subsample (17%) approximates reasonable statistics for clinic and population prevalence of GDM in pregnant Latina women.

The study question assesses gestational weight gain predictors of GDM for the subsample, who may be at potentially higher risk of GDM for having failed the initial screening. Similar to the Diabetes Prevention Program (DPP) trial to prevent diabetes among pre-diabetics at higher risk of DM, assessing weight gain among those at potentially higher risk of GDM could inform risk prevention strategies for a vulnerable group. [120]

Availability of data was constrained for some clinical predictors of GDM in the index pregnancy. We were unable to assess GDM in prior pregnancies due to availability of recording in the electronic clinical records. Moreover, complete birth history was

unavailable for many immigrant women, many of whom had births in home countries where GDM may not have been assessed. Covariates such as hypertension and depression were not included in the model due to unavailability of clinical recording of diagnoses in the prenatal dataset.

We primarily assessed clinical predictors since fewer socio-demographic and lifestyle factors were recorded within the electronic clinical records for inclusion in the dataset. While the clinic population overall was low-income, socioeconomic status was not assessed in terms of education or income variables. Acculturation in measures such as English fluency or length of time in the United States was also not assessed. Lifestyle factors such as diet and physical activity, which are established predictors of GDM, were not available in a quantitative format. A composite of health promotion encounters within the electronic clinical records was not readily available. Assessment of the frequency and timing of encounters with health promotion services (e.g., nutritionist or health educator) could inform participant utilization and its potential association with weight or GDM.

Due to delivery in the hospital rather than at the Mary's Center clinic, we were unable to track maternal or child outcomes associated with GDM. For instance, delivery complications of cesarean section, preeclampsia, or birth weight of baby to assess macrosomia.

Measurement validity of certain variables is a limitation. Self-reported pre pregnancy weight may be under or over reported. In particular, the low-income immigrant population may be less aware of their weight due to fewer healthcare visits. However, we have no reason to believe in differential reporting between those with GDM and those without.

Despite the above limitations, the study contributes to the literature base of gestational weight gain as it relates to GDM for Latina immigrant women.

Strengths

This study has a number of strengths.

This study comprises a large sample of low income Latina women who face greater risk of diabetes but are understudied in the literature. This study therefore addresses gaps in health disparity research by examining factors associated with GDM in a large, majority Central American immigrant population to provide needed research for this Latino subgroup. Latino subgroup differentiation is called for in literature, particularly since prevalence and risk factors of diabetes differ among them.[100] This is one of the few studies representing the significant Central American population in the Washington, D.C. metropolitan area; with nearly half from El Salvador, followed by Guatemala and Honduras.

This is the first prenatal dataset constructed at Mary's Center, and the first extensive study of GDM risk factors for their Latina population. Mary's Center clinicians identified GDM as the most frequent complication for their pregnant women, and identified subsequent conversion to prediabetes and DM as a growing concern. This analysis contributes to understanding of factors that influence GDM that may inform prevention strategies for this large Central American immigrant population.

Moreover, this study address priorities in diabetes research by contributing to the clinical understanding of total and trimester-specific weight gain during pregnancy and its association with GDM for a Latina population. The results may inform clinical and behavioral implications for teachable moments and points of intervention as they relate to healthy weight gain during pregnancy. Programs and clinical counseling during and

between pregnancies may reduce the risk of GDM, particularly for those exhibiting elevated risk for GDM such as obese women. For instance, nutrition and health promotion interventions implemented during pregnancy mark potential opportunities to optimize weight gain in order to prevent GDM, later diabetes, and risk of GDM recurrence.

Figure 1: STROBE flowchart of participants for inclusion/exclusion in the study population

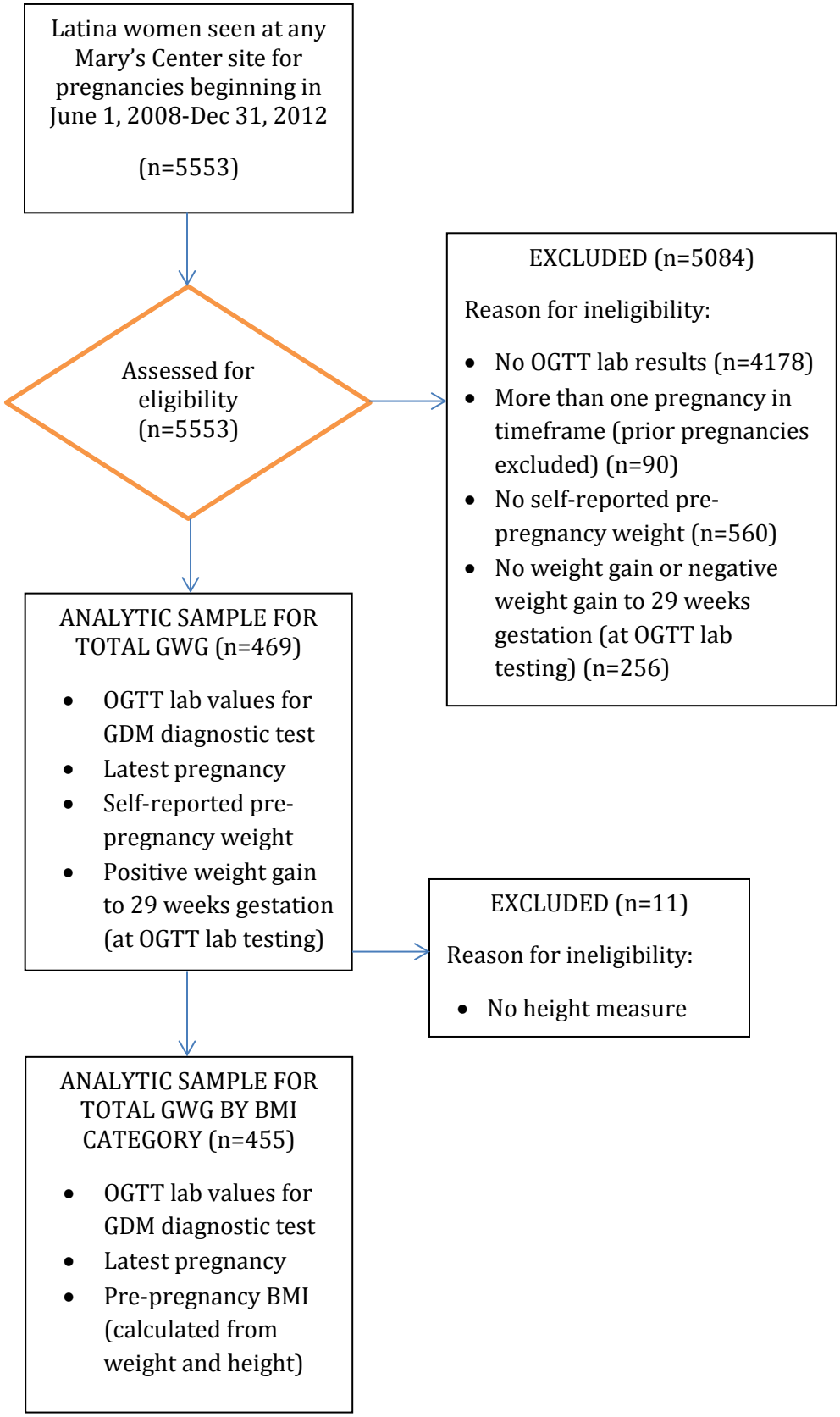


Table 1: Characteristics of the study population: Mary's Center June 1, 2008- December 31, 2012 **(n=469)**

Characteristic	Non-GDM (n=394)			GDM (n=75)		*P**
	N	(%)		n	(%)	
Age at pregnancy begin (y)						
15-24	118	(30.0)		19	(25.3)	**0.44**
25-29	135	(34.3)		25	(33.3)	
30-34	83	(21.1)		22	(29.3)	
35-45	58	(14.7)		9	(12.0)	
Race/Ethnicity						
Latina		**100%**				
Country of origin						**0.05***
El Salvador	182	(46.2)		38	(50.7)	
Guatemala	74	(18.8)		17	(22.7)	
Honduras	34	(8.6)		9	(12.0)	
Mexico	41	(10.4)		9	(12.0)	
Other	63	(16.0)		2	(2.7)	
Parity						**0.88**
1	369	(93.7)		71	(94.7)	
2	24	(6.1)		4	(5.3)	
3	1	(0.3)		0	(0)	
Pre-pregnancy BMI category						**<0.01***
Underweight	4	(1.0)		0	(0)	
Normal	119	(30.2)		17	(22.7)	
Overweight	179	(45.4)		32	(42.7)	
Obese	81	(20.6)		23	(30.7)	
Unknown	11	(2.8)		3	(4.0)	
Employment						**0.11**
Full time employed	63	(16.0)		14	(18.7)	
Part time employed	65	(16.5)		19	(25.3)	
Not employed	212	(53.8)		33	(44.0)	
Self employed	2	(0.5)		2	(2.7)	
Unknown	6	(1.5)		0	(0.0)	
Marital status						**0.39**
Single	158	(40.1)		37	(49.3)	
Partner	117	(29.7)		17	(22.7)	
Married	108	(27.4)		21	(28.0)	
Separated/divorced/widowed	7	(1.8)		0	(0.0)	

Unknown	4	(1.0)		0	(0.0)	
Insurance type						**0.14**
Commercial insurance	10	(2.5)		1	(1.3)	
Alliance	85	(21.6)		27	(36.0)	
Medicaid	37	(9.4)		7	(9.3)	
Underinsured	5	(1.3)		0	(0.0)	
Uninsured	37	(9.4)		5	(6.7)	
Unknown	220	(55.8)		35	(46.7)	
Federal Poverty Level						**0.25**
0-50	25	(6.3)		4	(5.3)	
51-100	75	(19.0)		13	(17.3)	
101-150	141	(35.8)		19	(25.3)	
151-200	23	(5.8)		3	(4.0)	
>200% poverty	7	(1.8)		2	(2.7)	
Unreported	123	(31.2)		34	(45.3)	
Smoking history						**0.20**
Non smoker	201	(51.0)		43	(57.3)	
Current smoker	1	(0.3)		0	(0)	
Former smoker	2	(0.5)		0	(0)	
Unknown	190	(48.2)		32	(42.7)	
Entry to prenatal care						**0.38**
1st trimester	229	(58.1)		50	(66.7)	
2nd trimester	159	(40.4)		24	(32.0)	
3rd trimester	6	(1.5)		1	(1.3)	
Blood pressure at 1st prenatal visit						**0.23**
Normal	304	(77.2)		56	(74.7)	
Prehypertension	79	(20.1)		19	(25.3)	
Hypertension	11	(2.8)		0	(0.0)	

Table 2. Odds ratio of GDM associated with total weight gain and rate of weight gain during pregnancy

	Non-GDM	GDM	Unadjusted OR		Adjusted OR*	
	n (%)	n (%)	OR (95% CI)	P value	OR (95% CI)	P value
Total weight gain up to GDM screening (lb) (n=469)	394 (84)	75 (16.0)	1.02 (1.0-1.04)	0.06	1.03 (1.0-1.05)	0.03
Total weight gain in 2nd trimester (lb) (n=332)	274 (83)	58 (17.5)	1.05 (1.0-1.1)	0.06	1.07 (1.0-1.14)	0.04
Rate of weight gain in 2nd trimester (lb/wk) (n=332)	274 (83)	58 (17.5)	1.87 (0.97-3.6)	0.06	2.4 (1.05-5.5)	0.04

GDM: gestational diabetes mellitus, BMI: body mass index, OR: odds ratio

GDM screening refers to OGTT test

---

* **Total weight gain up to GDM screening:** Adjusted for age, pre-pregnancy BMI, and parity.

Total weight gain and rate of weight gain in 2nd trimester: Adjusted for age, BMI at beginning of 2nd trimester, and parity.

Table 3. Odds ratio of GDM associated with total weight gain and rate of weight gain during pregnancy, by pre-pregnancy BMI category

	Non-GDM	GDM	Unadjusted OR		Adjusted OR*	
	n (%)	n (%)	OR (95% CI)	P value	OR (95% CI)	P value
Total weight gain up to GDM screening (lb) (n=455)	383 (84)	72 (15.8)				
Underwt/Normal (ref)			1	-	1	-
Overweight			1.33 (0.71-2.51)	0.38	1.29 (0.68-2.45)	0.44
Obese			2.38 (1.18-4.8)	0.02	2.31 (1.14-4.70)	0.02
Total weight gain in 2nd trimester (lb) (n=211)	175 (83)	36 (17.1)				
Underwt/Normal (ref)			1	-	1	-
Overweight			1.38 (0.55-3.5)	0.49	1.23 (0.48-3.15)	0.67
Obese			3.57 (1.28-9.96)	0.02	3.35 (1.18-9.5)	0.02
Rate of weight gain in 2nd trimester (lbs/wk) (n=211)	175 (83)	36 (17.1)				
Underwt/Normal (ref)			1	-	1	-
Overweight			1.33 (0.53-3.36)	0.55	1.19 (0.46-3.03)	0.72
Obese			3.48 (1.26-9.64)	0.02	3.27 (1.16-9.21)	0.025
IOM recommendations for rate of weight gain in 2nd trimester (n=211)						
Below/met	139 (79.4)	32 (88.9)	1	-	1	-
Exceeded	36 (20.6)	4 (11.1)	0.76 (0.17-3.42)	0.72	0.79 (0.17-3.65)	0.77

GDM: gestational diabetes mellitus, BMI: body mass index, OR: odds ratio, IOM: Institute of Medicine

GDM screening refers to OGTT test

---

* **All models:** Adjusted for age, pre-pregnancy BMI category, and parity.

Note: Pre-pregnancy BMI category included as covariate in this set of analyses to facilitate comparison with 2009 IOM guidelines on pregnancy weight gain (provided by pre-pregnancy BMI category)

REFERENCES

1. Chen L, Mayo R, Chatry A, Hu G. Gestational Diabetes Mellitus: Its Epidemiology and Implication beyond Pregnancy. Current Epidemiology Reports. 2016: 1-11.

2. Ferrara A. Increasing prevalence of gestational diabetes mellitus: a public health perspective. Diabetes Care. 2007; **30 Suppl 2**: S141-6.

3. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2012; **35 Suppl 1**: S64-71.

4. Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, Damm P, et al. International association of diabetes and pregnancy study groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. Diabetes Care. 2010; **33**(3): 676-82.

5. Ben-Haroush A, Yogev Y, Hod M. Epidemiology of gestational diabetes mellitus and its association with Type 2 diabetes. Diabet Med. 2004; **21**(2): 103-13.

6. Karakosta P, Alegakis D, Georgiou V, Roumeliotaki T, Fthenou E, Vassilaki M, et al. Thyroid Dysfunction and Autoantibodies in Early Pregnancy Are Associated with Increased Risk of Gestational Diabetes and Adverse Birth Outcomes. J Clin Endocrinol Metab. 2012.

7. Buschur E, Kim C. Guidelines and interventions for obesity during pregnancy. Int J Gynaecol Obstet. 2012; **119**(1): 6-10.

8. Hedderson MM, Gunderson EP, Ferrara A. Gestational weight gain and risk of gestational diabetes mellitus. Obstet Gynecol. 2010; **115**(3): 597-604.

9. Brunner S, Stecher L, Ziebarth S, Nehring I, Rifas-Shiman SL, Sommer C, et al. Excessive gestational weight gain prior to glucose screening and the risk of gestational diabetes: a meta-analysis. Diabetologia. 2015; **58**(10): 2229-37.

10. Gante I, Amaral N, Dores J, Almeida MC. Impact of gestational weight gain on obstetric and neonatal outcomes in obese diabetic women. BMC Pregnancy Childbirth. 2015; **15**: 249.

11. Cox Bauer CM, Bernhard KA, Greer DM, Merrill DC. Maternal and neonatal outcomes in obese women who lose weight during pregnancy. J Perinatol. 2016.

12. Chasan-Taber L. Physical activity and dietary behaviors associated with weight gain and impaired glucose tolerance among pregnant Latinas. Adv Nutr. 2012; **3**(1): 108-18.

13. Academies IoMaNRCotN. Weight Gain During Pregnancy: Reexamining the Guidelines. 2009.

14. Viswanathan M, Siega-Riz AM, Moos MK, Deierlein A, Mumford S, Knaack J, et al. Outcomes of maternal weight gain. Evid Rep Technol Assess (Full Rep). 2008; (168): 1-223.

15. Hutcheon JA, Oken E. Towards Defining Optimal Gestational Weight Gain. Current Epidemiology Reports. 2016: 1-7.

16. Kim C, Newton KM, Knopp RH. Gestational diabetes and the incidence of type 2 diabetes: a systematic review. Diabetes Care. 2002; **25**(10): 1862-8.

17. England LJ, Dietz PM, Njoroge T, Callaghan WM, Bruce C, Buus RM, et al. Preventing type 2 diabetes: public health implications for women with a history of gestational diabetes mellitus. Am J Obstet Gynecol. 2009; **200**(4): 365 e1-8.

18. Bennett WL, Robinson KA, Saldanha IJ, Wilson LM, Nicholson WK. High priority research needs for gestational diabetes mellitus. J Womens Health (Larchmt). 2012; **21**(9): 925-32.

19. Kim C, Berger DK, Chamany S. Recurrence of gestational diabetes mellitus: a systematic review. Diabetes Care. 2007; **30**(5): 1314-9.

20. Schwartz N, Nachum Z, Green MS. The prevalence of gestational diabetes mellitus recurrence--effect of ethnicity and parity: a metaanalysis. Am J Obstet Gynecol. 2015; **213**(3): 310-7.

21. Jones EJ, Roche CC, Appel SJ. A review of the health beliefs and lifestyle behaviors of women with previous gestational diabetes. J Obstet Gynecol Neonatal Nurs. 2009; **38**(5): 516-26.

22. Pabon-Nau LP, Cohen A, Meigs JB, Grant RW. Hypertension and diabetes prevalence among U.S. Hispanics by country of origin: the National Health Interview Survey 2000-2005. J Gen Intern Med. 2010; **25**(8): 847-52.

23. Hedderson MM, Darbinian JA, Ferrara A. Disparities in the risk of gestational diabetes by race-ethnicity and country of birth. Paediatr Perinat Epidemiol. 2010; **24**(5): 441-8.

24. Torres R. Access Barriers to Prenatal Care in Emerging Adult Latinas. Hispanic Health Care International. 2016; **14**(1): 10-6.

25. CDC. Summary Health Statistics for U.S. Adults: 2012. 2014.

26. Amaro H, de la Torre A. Public health needs and scientific opportunities in research on Latinas. Am J Public Health. 2002; **92**(4): 525-9.

27. Carbone ET, Rosal MC, Torres MI, Goins KV, Bermudez OI. Diabetes self-management: Perspectives of Latino patients and their health care providers. Patient Education and Counseling. 2007; **66**(2): 202-10.

28. Flegal KM, Ezzati TM, Harris MI, Haynes SG, Juarez RZ, Knowler WC, et al. Prevalence of diabetes in Mexican Americans, Cubans, and Puerto Ricans from the Hispanic Health and Nutrition Examination Survey, 1982-1984. Diabetes Care. 1991; **14**(7): 628-38.

29. Torres JM, Wallace SP. Migration circumstances, psychological distress, and self-rated physical health for Latino immigrants in the United States. American journal of public health. 2013; **103**(9): 1619-27.

30. Mary's Center for Maternal and Child Care webpage. [cited 2016 Feb 22]; Available from: http://www.maryscenter.org/

31. Zong J, and J. Batalova. Central American Immigrants in the United States. 2015 [cited 2016 Feb 22]; :[Available from: http://www.migrationpolicy.org/article/central-american-immigrants-united-states

32. Gestational Diabetes Mellitus. Diabetes Care. 2003; **26**(suppl 1): s103-s5.

33. Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN, et al. Recommendations for Blood Pressure Measurement in Humans and Experimental Animals: Part 1: Blood Pressure Measurement in Humans: A Statement for Professionals From the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. Hypertension. 2005; **45**(1): 142-61.

34. StataCorp. Stata Statistical Software: Release 11. College Station, TX: StataCorp LP; 2009.

35. Coustan DR, editor. Medical Management of Pregnancy Complicated by Diabetes. 5th ed; 2013.

36. Walker LO. Managing excessive weight gain during pregnancy and the postpartum period. J Obstet Gynecol Neonatal Nurs. 2007; **36**(5): 490-500.

37. Boghossian NS, Orekoya O, Liu J, Liu J. Pregnancy Interventions or Behaviors and Cardiometabolic Biomarkers: a Systematic Review. Current Epidemiology Reports. 2016: 1-12.

38. Chin JR, Murtaugh MA, Silver R. Obesity: Implications for Women's Reproductive Health. Current Epidemiology Reports. 2014; **1**(1): 17-26.

39. Mamun AA, Mannan M, Doi SAR. Gestational weight gain in relation to offspring obesity over the life course: a systematic review and bias-adjusted meta-analysis. Obesity Reviews. 2014; **15**(4): 338-47.

40. Sridhar SB, Darbinian J, Ehrlich SF, Markman MA, Gunderson EP, Ferrara A, et al. Maternal gestational weight gain and offspring risk for childhood overweight or obesity. Am J Obstet Gynecol. 2014; **211**(3): 259 e1-8.

41. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med. 2002; **346**(6): 393-403.

H. MANUSCRIPT 2

TITLE: Capitalizing on Teachable Moments to Promote Healthy Eating and Diabetes Prevention among Low-Income Central American Pregnant Immigrant Women

INTRODUCTION

Healthy eating promotion is critical for prevention of obesity and diabetes, which continue to rise globally at rapid rates.[121] In 2016, the first World Health Organization global report on diabetes demonstrated that adults living with diabetes have nearly quadrupled to 422 million since 1980.[122] Effective and novel strategies to promote healthy eating, physical activity, and avoid excessive weight gain are urgently needed to prevent diet-related chronic diseases.[49, 123] One such strategy may be the identification and use of *teachable moments*, which refers to an event or circumstance in an individual's life, often a naturally occurring life transition, which may motivate individual adoption of risk-reducing behaviors.[55]

Nearly half of Latina mothers in the United States begin pregnancies overweight or obese, and face greater risk for diabetes at each BMI level compared to non-Latina whites.[14] Central Americans immigrants (CAI) are a vulnerable Latino subgroup facing health disparities – often experiencing economic hardship and political instability in their native countries - yet remain understudied in the literature.[109] Central American immigrants comprise the largest Latino subgroup in the Washington DC metropolitan area.[109] Strikingly, Latino American children born today have a 50% chance of developing type 2 diabetes mellitus (T2DM) in their lifetime.[124] These alarming statistics underscore the need for culturally tailored diabetes prevention and treatment efforts for Latino Americans.

Providers play a critical role in the assessment and communication of chronic disease risks to support preventive behaviors.[40] Identification of novel strategies for communicating risk and exploration of affective and emotional drivers in decision-making may contribute to behavioral theory to address the challenge of chronic disease prevention.

We take a life course approach to investigate pregnancy as a teachable moment for healthy eating. Life course approaches applied to health promotion have been posited as a way to alter diet and obesity and to reduce health disparities by addressing racial/ethnic differences beginning in early life.[52-54] The life course provides a compelling framework for diabetes prevention, given the progression of illness and accumulation of risk or protective factors over the lifespan.[48] Researchers have suggested focusing on pregnancy as a teachable moment considering both the mother's potentially heightened receptivity and motivation to improve her health (and the health of her baby) as well as the increased likelihood of clinical contact during that period and the opportunities for intervention it presents.[34, 56] We thereby sought to investigate the potential of pregnancy as a teachable moment for healthy eating promotion and diabetes prevention over the life course.

Emerging research has applied teachable moments to a range of health conditions. Studies have demonstrated pregnancy as a key time period for smoking cessation, attributed to mother's health concerns for baby and self, as well as social pressure not to smoke.[57] Researchers have also found moderate support for a cancer diagnosis as a teachable moment for healthy eating; the opportunity could be improved if providers are better informed of and communicate the relation between diet and cancer recurrence.[125] The need remains for identification of compelling teachable moments in the life course for healthy eating; pregnancy appears promising.[126] Since mothers may consider their nutrition as influential for a developing baby, we hypothesized that pregnant mothers may be receptive to making healthy eating changes.[127]

During pregnancy, the constructs of a teachable moment- risk perception, emotion, and redefining self-concept and social roles – may be highly salient for expectant mothers (See Figure 1). Specifically, McBride posited teachable moments as cueing events that: 1) increase perceptions of personal risk and outcome expectancies; 2) prompt strong affective or emotional responses, and 3) redefine self-concept or social roles.[55] Emotion and self-concept may be highly present during the transition of pregnancy – activating a role that is profoundly emotional in its frequent coupling of excitement and anxiety. Risk perception may increase for expectant mothers concerned for their own and their baby's health, and may subsequently prompt adoption of healthier behaviors. For Latinas, *familism* is a strong valuation of the family that may have bearing on identity construction and social roles and serve as a motivating driver of behavior change.[30]

To understand how the teachable moment works in this setting, we drew upon adult learning theories from educational psychologist Mezirow, who developed the theory of transformative learning from Habermas' concept of communicative action. Mezirow explicates how adult learning occurs through two learning domains, instrumental (evidential) and communicative (dialogical) learning. These learning domains, when infused with critical reflection, have the potential to result in a process of transformative learning. We explore how providers might assist women in engaging in the latter process to facilitate learning conducive to longer-term behavior change.

Further linking diet and health, pregnancy also carries with it the risk of gestational diabetes mellitus (GDM). As one of the most common pregnancy complications, GDM affects 7% to 18% of women in the United States depending on the population characteristics and screening practices.[2, 3] GDM is abnormal glucose tolerance that manifests late in the second trimester as a result of physiologic changes in pregnancy exacerbated by pre-existing risk

factors such as obesity or pre-diabetes.[5] The tangible health risk, of which management is primarily diet-controlled, may contribute to an elevated risk perception and serve as additional motivation for healthy eating changes. Notably, women who have had GDM face a seven-fold increased risk of developing T2DM in the future, with 20-60% of gestational diabetics developing T2DM in the 5-16 years post-pregnancy.[6, 7] The high-risk period during and after pregnancy therefore signals a critical time for lifestyle modification to reduce the incidence of both GDM and T2DM.[8, 9]

This is the first study to explore teachable moments for healthy eating promotion and diabetes prevention for a primarily Central American immigrant population facing health disparities using qualitative methods. We applied a novel teachable moments framework to identify effective strategies to initiate and sustain behavior change over the life course to address the burden of non-communicable chronic disease.

We therefore look to pregnancy as an evocative transition for women for whom highly salient emotions, changing roles, and health perceptions might support and cultivate healthy lifestyle change. Since effective teaching hinges on the dynamics of learning, we explore the process of learning and health behavior change through qualitative interviews with CAI women accessing prenatal services and their health care providers. We seek to understand how CAI women learn, to generate insight for providers to capitalize on pregnancy as a teachable moment for healthy eating and diabetes prevention.

We investigate the following questions through a qualitative study:

1. How do Central American immigrant (CAI) women learn to change their diet?

2. What is the potential of pregnancy as a teachable moment (TM) for dietary change and diabetes prevention?

METHODS

We conducted a qualitative study comprised of 43 in-depth interviews with health care providers and pregnant and postpartum CAI women, and prenatal chart reviews.

Setting

We formed an academic--community collaboration and conducted the research at Mary's Center, a large Federally Qualified Health Center (FQHC) in Washington, D.C. that provides maternal and child care services to participants regardless of their ability to pay. We selected the sample of providers and CAI women accessing prenatal services from the DC site. We chose this clinical setting because it serves a large Central American immigrant population (approximately 75%) with high rates of obesity and GDM. Clinic estimates show that half of its participants are obese and approximately 17% have GDM.

Study sample

The sample of pregnant women comprised low-income, urban immigrant Central American adults accessing prenatal services at the FQHC, with the following inclusion criteria: ages 18-45 years old, tested for GDM, at least 28 weeks gestation, and not having health or lifestyle factors that would make participation a burden. We followed up with the same women for postpartum interviews approximately 3-6 months after delivery. We purposively sampled CAI women using critical case and maximum variation sampling, to generate a case study sample of GDM and non-GDM subgroups with each representing a diversity of characteristics (i.e., age, parity, family history, risk factors) to allow for richer exploration of relevant themes.

Health care providers (ages 18 and older) were purposively sampled based on the frequency and relevance of their communication with pregnant women about diet, diabetes,

and health. These included: obgyns, nutritionists, WIC nutritionists, nurses, midwives, case managers, and care coordinators - reflecting the coordination of care at the clinic.

The final sample of 43 in-depth interviews (IDIs) comprised: 13 IDIs with providers, 20 IDIs with pregnant women (10 GDM; 10 non-GDM), and 10 IDIs with postpartum women (7 GDM; 3 non-GDM). Data collection took place from March 2014-February 2015. The majority of provider interviews was conducted prior to interviews with CAI women, and informed the questions and context of the latter interviews.

Data collection

All participants were enrolled using Johns Hopkins University IRB-approved recruitment and informed consent forms. Consents were signed immediately prior to conduct of the interview. Interviews were primarily conducted in the clinic; with some follow-up interviews conducted at a convenient location of the participants' choosing (e.g., library, home). As compensation for their time, all participants were offered USD 20 in cash after the interviews.

Interviews lasted approximately 60-90 minutes and were audio recorded. All provider interviews were conducted in English and transcribed verbatim by the student researcher (KL). CAI interviews were conducted in Spanish (with the exception of one in English with a bilingual participant) by the bilingual researcher (KL). CAI interviews were transcribed verbatim by native Spanish speakers and reviewed by KL for completeness and accuracy.

KL conducted chart reviews after initial interviews with CAI women to obtain information on the clinical and behavioral context (e.g., risk factors, diet, and GDM management) for data triangulation.

Data analysis

We analyzed the qualitative data using the framework method developed by the Social and Community Planning Research Institute.[94] Using a case study approach, we conducted a cross-case analysis between the two subgroups of prenatal women who developed GDM and those who did not. KL developed the codebook inductively beginning with open coding on a subset of interviews, then deductively added existing themes from the interview guide. The codebook was refined with a native Spanish speaking research assistant (CG) by discussing definitions and interpretation of themes applied to a subset of interviews. KL thematically coded the interviews with providers and CAI women using Atlas.ti qualitative analysis software (Berlin, Scientific Software Development). The same codebook was applied to both sets of interview data.

KL conducted the indexing (coding) and analysis in Spanish to retain the meaning, context, and idiomatic expressions. During this analytic phase, KL and CG met consistently to discuss linguistic and cultural interpretations of the interview data.

We construed receptivity as an attitude of openness or willingness to receive information or advice that in turn supports behavior change. Receptivity was typically assessed during in-depth interviews when CAI women reported recommendations they received from their health care provider, followed by either 1) their stated agreement with the recommendation or 2) reports of behavior change in accordance with those recommendations. Some women specifically attributed their behavior change to information conveyed by their provider. Receptivity was also demonstrated as openness to receiving information from other sources such as family members or peers. Evidence of receptivity early in pregnancy was often demonstrated by women's stated expressions of information- seeking related to the health of themselves and their baby. For instance,

women stated that they looked up health information online about what foods are good for their baby, spoke to other mothers among their friends or family, or had many questions to which they sought answers. Receptivity, therefore, was gauged as women's interest in obtaining information, as well as women's openness to receiving and reflecting on that information. Receptivity was also demonstrated by women's stated alignment in attitudes or actual behavior change as a result of the recommendations they had received.

RESULTS

The main data sources (CAI women and provider interviews) were considered for their thematic relevance to the research questions, and confirming and disconfirming data were sought out for comparison between them. Below we present the themes by the teachable moments constructs.

How Central American immigrant (CAI) women learn to change their diet

CAI women who sustained healthy eating changes appeared to engage in a process of transformative learning during pregnancy that embodied critical reflection. Notably, the process of learning for health behavior change appeared to correspondingly match each of the teachable moment constructs (see Figure 1).

Redefining self-concept and social role to guard family health. Perspective transformation occurred when CAI women redefined their self-concept as guardian and primary influencer of family health, with managing nutrition as a central aspect of that role. Mothers' principal motivation for behavior change embodied *familism* in its outlook. As one mother explained, "I know that the well-being of my family depends on eating healthier. There will be fewer illnesses and visits to the clinic" (Age 43, GDM, Prior GDM). Many CAI women also expressed concern for the health risks of their young children. One mother

noted: "I have to take better care of myself for my own good and that of my baby. In my house I also need to take better care of my children that are a little fat" (Age 43, GDM, Prior GDM). She recognized that the family diet shapes how her children grow up and wanted to set healthy changes in place for the whole household.

Resilience from overcoming adversity and continuing to navigate challenges also activated the CAI mother's role to safeguard the health of her children. When healthy eating became salient to them as critical for their children's well-being, some mothers assumed responsibility to ensure that their family ate well to stay well. Central to CAI mothers' social roles is to provide the best for their children, particularly in light of the sacrifices they made to establish a second life and family in the United States. One mother commented on healthy eating:

> It is a challenge because I would have to be fighting each day for my life and that of my children because one is always thinking of watching them grow and become grown-ups, so it [eating healthfully] would be something more difficult and more painful but with a lot more responsibility. (Age 43, GDM, Prior GDM)

To "*seguir luchando*," or continue fighting, emerged as a powerful theme cued as a positive coping response to the challenge of initiating and maintaining healthy dietary change. When driven by resilience and hope, CAI mothers redefined their role around steering the family in a healthier direction for a better future. Perspective transformation occurred when CAI mothers linked a healthy family diet to continuing to fight for their collective health and livelihood.

Activating emotional responses to stay healthy for the family. Women expressed strong emotional and social motivations for continuing behavior changes; for instance, deep concern and love for the baby and caring for the family. The emotional period of pregnancy

may activate maternal perceptions of vulnerability along with strength and resolve to address challenges. As one mother stated: “I don't want to be sick, and I don't want to have anything - I don't want to die! Because I want to see my girls grow up and so I want, I want to be very healthy for them” (GDM, postpartum interview). CAI women’s desire to remain a part of their children’s lives often fueled their dedication to take care of themselves.

Increasing perception of maternal and fetal risks. Mothers with GDM perceived greater risks to their own and their baby’s health. Sustaining healthy changes depended on continuing to perceive risk: "Some women 3 or 5 years after [pregnancy] already develop regular diabetes. That's why I try to take care of myself because I don't want to have diabetes" (GDM, postpartum interview). Other mothers without GDM who understand their own risk factors for diabetes, may also adopt healthy behaviors. One mother whose close family had suffered from illnesses stated, “I want to take care of myself, so that it doesn’t happen to me. The doctors know, they know. I tell you, because of this I come to do my physical check-ups and all that. It scares me” (Age 32, no GDM, first baby).

Taken together, the process of transformative learning for healthy dietary change encompassed all three constructs of a teachable moment; that is, CAI women critically reflected on their self-concept and social role, activated emotional responses, and perceived risk to themselves and their families. This mother’s narrative shows the emergence of a new perspective through an internal reflective process:

> Same, I want to continue eating the same, now that I am used to it. I don’t want to eat poor quality foods that are damaging to the body. For my health…I don’t want to gain a lot of weight or be very fat...before I didn't pay attention to these things but now I want to be different, to be healthier, for my work and to be attentive to my

girls and take care of them better. For the love of my girls. (Age 26, GDM, first babies)

Providers supported women in their learning process largely by communicating the clinical risks; the presence of GDM or a comorbidity would prompt counseling. Providers recognized that mothers were highly motivated to safeguard their baby's health during pregnancy. As such, they attempted to educate them about health risks to the mother and baby during pregnancy, which in turn activated emotional responses prompting behavior change.

While fear and immediate risk perception effectively directed CAI behavior change during pregnancy, sustaining these changes longer-term necessitated that mothers adopt a life course perspective for continued effects on the baby and herself. Activating CAI women's social role was central to this process. One provider described her approach:

> With time, I try to change my approach to involve them into understanding that they are the pillar of their families, and they are to care for the kid as much when they're inside them as when they are out. Because I tell them that what they feed them is what will become the adult (Female health care provider).

To more fully capitalize on the teachable moment, providers who cue the social role construct within the interaction may facilitate CAI women's learning process through critical assessment, self-awareness, and recognition of the transition to lifelong family health.

Pregnancy as a teachable moment (TM) for dietary change and diabetes prevention

Capitalizing on a teachable – and learnable – moment of pregnancy

Interviews with both providers and CAI women supported pregnancy as a potent teachable moment for dietary change and diabetes prevention. The cueing event of pregnancy can be considered a *teachable* moment as well as a *learnable* moment, a prime opportunity for behavior change. Nurses and health educators who counseled all adults noted greater success with their pregnant women in making lifestyle changes compared to those who were not. They described pregnant women as more "receptive" and "motivated to do what is best for her child" when learning about and making healthy eating changes. We construe receptivity as an attitude of openness or willingness to receive information or advice that in turn supports behavior change.

Pregnant women intuitively sense that their health influences their baby; as one woman stated, "I think that if you eat healthy the baby will be born healthy…it helps a lot." (Age 40, prior GDM). The significant transition marked by a mother's high motivation to do what is best for her child characterizes pregnancy as a teachable moment.

The cueing event of pregnancy powerfully influenced behavior. One woman had long attributed her constant illnesses to poor diet, yet admitted low prior receptivity to provider counseling: "I wasn't pregnant so I would've never even listened." (Age 20, non-GDM, first baby). Many women similarly acknowledged beginning or increasing their commitment to healthy eating changes during pregnancy. The pregnancy period - when mothers are highly attuned to risks to the baby – combines emotion, risk perception, and redefining self-concept and social role to create a dynamic opportunity for behavior change.

Moreover, many mothers were not only receptive during pregnancy, but reportedly engaged in information-seeking: "many things that no one told me about, I search for on the Internet" (Age 32, no GDM, first baby). Mothers—particularly those having their first baby—sought to learn as much as they could about how to be healthy for themselves and

for their babies. One mother said, “Me and my partner are very curious, we figure everything out on the Internet” (Age 29, non-GDM). Despite having lower literacy, CAI women actively sought information from a variety of media, such as following motherhood pages on Facebook (“I just click and they send to me like I’m registered”), searching and reading online websites (“on google”), and watching television programs about pregnancy, health, and weight. One woman learned about her baby’s taste development, stating “On the Internet…when you are cooking, the baby can sense the smell of the food” (Age 32, no GDM, first baby).

Mother’s high curiosity resulted in active media consumption as well as interpersonal communication with family, friends, and peers. One mother’s account illustrated these multiple sources of knowledge and influence: “My brothers look at my plate and want me to eat double for her and for me, and I tell them that it is pure myth. The internet said that it’s a myth” (Age 33, non-GDM).

Conceivably, not all of the information obtained from the media or social networks may be appropriate for the woman’s particular experience. Providers interviewed spoke of varied information sources as an opportunity to counsel on nutrition and health, “it starts the conversation…if it’s not consistent with what we know to be true, then I, I correct them” (Male health provider).

Notably, the high receptivity cut across both subgroups of our case study; we had explored two participant subgroups who we hypothesized might perceive differing levels of risk based on the existence of a GDM diagnosis. As expected, GDM women largely followed the strict dietary changes to manage their condition once diagnosed in the late second trimester. However, women without GDM are also highly receptive to healthy eating changes during pregnancy based on the information-seeking behavior exhibited early on. A

third group emerged of women who had preexisting comorbidities or risk factors for GDM (e.g., cholesterol, high blood pressure, family history of diabetes, GDM in a prior pregnancy). Providers tracked and counseled such women early in pregnancy, which increased their risk perception and receptivity to healthy eating changes. The teachable moment therefore encompasses all pregnant women who perceive a strong link between the foods they eat and the health of themselves and their babies, to varying degrees based on their perceived level of risk.

Enhancing the counseling opportunity: three critical teachable moments

We explored the degree to which the providers in the community clinic utilize the pregnancy period as a teachable moment. Largely, providers relied on clinical indicators of risk to drive counseling on healthy eating and diabetes prevention. Risk identification tended to correspond with two time periods during pregnancy: (1) In the first trimester, counseling occurred with early risk detection for women who had GDM in a prior pregnancy, family history of diabetes, diet-related comorbidities such as hypertension or high cholesterol, or very high pre-pregnancy weight; (2) In the late second trimester, counseling coincided with a GDM diagnosis, whereas non-GDM women received little to no explanation of the condition. Provider counseling largely took place in line with expected or existing conditions; pregnant women at higher risk for complications received both medical visits and supportive health promotion referrals to nutritionists.

While the existing process provided effective obstetric care, it underutilized the critical opportunity for health promotion to prevent chronic disease. Many CAI women were motivated to learn about and make changes based simply on their desire to provide better nutrition for their baby. The majority was also overweight and expressed a strong desire to make healthy lifestyle changes to lose weight postpartum, enhancing the potential of the

teachable moment. The existing process of risk identification, while catching those at highest risk, misses an opportunity to engage all pregnant women in healthy lifestyle change at a highly receptive period of time in the life course. Given the high contribution of overweight to occurrence of GDM and other comorbidities, intervention during pregnancy may have profound effects on risk reduction for a future pregnancy or for long-term chronic disease.

Based on CAI women and provider interviews, we therefore identify and describe the following three critical teachable moments during pregnancy to engage women in healthy eating and diabetes prevention.

- TM1: Around 14 weeks at end of 1st trimester; information-seeking; nutrition during pregnancy
- TM2: Around 28 weeks; testing for gestational diabetes and counseling on risks, managing GDM through diet control
- TM3: 8 weeks postpartum; reengaging in health services, creating a healthy family diet for well-being and to support child growth and development

TM1: Capitalizing on high receptivity and information-seeking behavior

The first teachable moment relatively early in pregnancy, at approximately 14 weeks gestation, takes advantage of mothers' high receptivity to health promotion counseling, at a stage appropriate to making dietary changes.

TM1 Preventing excess weight gain. The timing of the teachable moment at the end of the first trimester accounts for *variable entry to care*, to reach mothers with a standard health promotion discussion to orient them to the next stage of pregnancy. Mothers often begin *information-seeking* behavior upon confirmation of pregnancy; providers may guide them

with accurate resources for nutrition and health. This curiosity creates an opportunity to talk about GDM as one possible condition that may arise in pregnancy to increase awareness and enable possibility for *prevention*. The timing also coincides with physiological changes- when hormones contributing to nausea tend to alleviate. Women noted transitions in their eating during pregnancy, typically disrupted in the first trimester by nausea and vomiting commonly known as morning sickness. Many mothers could stomach very little, primarily fruit, and were advised by providers to "Every couple of hours, eat small frequent meals." At the second trimester transition, CAI could often begin eating again - even eating significantly larger amounts if following the widespread myth "*eating for two***.**" These changes in eating, coupled with motivation to nourish the baby, mark a critical teachable moment for nutritional counseling to promote healthier foods and guide appropriate weight gain. Importantly, excess *gestational weight gain* is one predictor of GDM, and pregnancy weight retention increases women's risk of overweight in the life course. The timing of this teachable moment aligns with identification of *higher risk groups* for the opportunity to educate, closely monitor, and connect women to health promotion resources.

TM1 Building self-efficacy for dietary change. To facilitate behavior change, earlier counseling capitalizes on more of the gestational period –- when mothers exhibit high receptivity and curiosity for making healthy changes. Gradually modifying eating habits over a six month period enables mothers to practice skills over a longer period of time that may lead to more successful and sustainable behavior change. Mothers expressed difficulty of dietary modification – "Everything that I like to eat, it's all bad for me {chuckles}" (Age 30, GDM, first baby). Beginning counseling earlier in pregnancy aids not only physiological adaptation, but reduces emotional distress if women develop GDM and need to quickly adapt to a strict diabetic diet. Early awareness may lessen stress or shock in the event of an

eventual diagnosis, and provide more time to make changes and develop or practice skills that can result in better *management* of the condition. Inability to do so could result in significant distress. One woman needing medication to manage her condition explained, "Sometimes when I am hungry and can't bear it I – I, I eat everything – everything that I see… I sit and I eat!" (Age 37, GDM).

Providers who help women recognize that "a diabetic diet is a healthy way to eat" assist women in reshaping their eating patterns while using pregnancy as a canvas for change. As a male health care provider described:

> You just have to have the patients motivated to maintain those lifestyle changes. And at least if she does it during pregnancy she knows she's done it before, so at that point it's just a matter of making the decision. People do what they feel is most important to them.

Providers can initiate life course change by helping women build self-efficacy during pregnancy for healthy eating and diabetes management.

TM2: Communicating risk at testing and diagnosis

GDM testing typically occurs during the late second trimester around 28 weeks gestation, and marks a fitting time for providers to converse with expectant mothers about healthy eating and GDM.

TM2 Testing: Perceiving risk; opportunity for education. Testing for GDM - irrespective of diagnosis - may increase awareness of a relatively unknown pregnancy condition and the risk it carries for diabetes. One younger mother with an elevated test result stated: "I used to think…you can get breast cancer and diabetes and all of that later, like in your 40s and 50s, but now I see that no, diabetes it's really close to me right now" (Age 20, non-GDM, first

baby). Although her second test did not confirm GDM, she felt more susceptible to diabetes based on her elevated initial test, recognizing that it could occur in the near-term. The testing – a useful prompt for education - sufficiently increased her risk perception, though it should be balanced with an accurate discussion of risk and how to prevent it. For the CAI population at greater risk often due to overweight and family history of diabetes, understanding the risks can motivate behavior change for future diabetes prevention.

TM2 Diagnosis: Perceiving risk; dietary intervention. For mothers who develop GDM, the diagnosis marks a strong teachable moment, particularly since managing the condition necessitates strict dietary intervention. Providers, particularly nutritionists, create tailored nutrition plans and discuss risks to the mother and baby. As one GDM woman stated: "In the future, when my son is born, he can be very large, or he can be diabetic…or in the future when my girl is born I could have diabetes type 2…if I don't take care at this moment in time" (Age 24, GDM, first baby). The majority of GDM mothers took the diagnosis and recommendations very seriously and changed their diet for the duration of the pregnancy to prevent harming the baby.

TM3: Reengage postpartum with health services

Mothers typically return eight weeks after delivery for a postpartum visit, which coincides with the follow-up GDM test to determine whether the condition resolved upon delivery.

TM3 Establishing a new pattern of eating. If GDM remained unresolved, providers may use the opportunity to follow-up to continue education on diet and diabetes. CAI women follow a specific cultural diet during their 40-day postpartum period, (known as *la dieta de 40 dias* or *la cuarentena*), when foods are limited to chocolate, tortillas, and cheese to aid the mother and the baby during recovery and breastfeeding. While CAIs follow the diet to

varying extents, they establish a new pattern of eating after the 40 day period. The postpartum visit around eight weeks, therefore, presents a critical opportunity to reengage women to create a plan for healthy eating in the future for themselves and their families. It may also be an opportune time to provide weight counseling, since many women expressed postpartum weight loss as a goal. Following this postpartum visit, continued care plays an integral part of recommitting to goals and fostering behavior change.

TM3 Expanding influence of maternal diet to family diet. Some mothers became less concerned about their diet once the baby was born and physically distinct – reflecting a "baby's out" mentality. One mother expressed her worry as: "How unhealthy I eat, and how I'm always getting sick so…it scares me. I want her to be out so she won't be affected" (Age 20, non-GDM, first baby). Breastfeeding extended the period of mother's perceived influence on the baby. Most breastfeeding mothers expressed motivation to eat healthy for reasons of staying healthy herself, nourishing the baby, or even to prevent transmitting her diabetes to the baby. The limited time period of breastfeeding, however, is further curtailed when CAI soon return to work. To extend the time period of perceived impact of the maternal diet, mothers must adopt a long-term perspective that the family diet continues to influence the baby's growth and development. As one mother stated: "He [partner] tells me that if we eat healthier then we won't get sick, because what I eat, I give to them [the family] as well" (Age 40, non-GDM, prior GDM).

Women were also motivated by weight control. Many pronounced postpartum goals to lose weight gained during pregnancy and over the years. One woman stated: "I want to maintain a normal weight and it is better for my health…In order to have good health, one needs to exercise and eat healthy" (Age 34, GDM). Women who wanted to achieve a healthy

weight often cited contributory lifestyle behaviors as a means to improve their health and well-being.

Providers may tailor counseling at the postpartum visit to women's motivation for weight loss, healthy eating, exercise, or prevention of illnesses. Counseling may also reframe mother's motivation for healthy eating around family health and well-being to extend the importance of her diet beyond gestation and breastfeeding.

Linking food to health: critical reflections on diet

Taken together, pregnancy marks a highly salient teachable moment to link food and health for mother and baby. The transitional life event often prompts mothers to examine their relationship with food, assess their eating patterns, and improve their understanding of how nutrition relates to weight, illness, and well-being. Many women spoke of their tendency prior to pregnancy to *comer de todo* meaning eating everything, referring to indiscriminate food choices and unrestricted quantities. One woman reflected:

> Before I never measured the consequences. I ate whatever I found...greasy foods, fried eggs, meats, oily foods all in the same plate. Now I try not to do it like that. Before, I ate until I felt bad from how much I had eaten (Age 43, GDM, prior GDM).

Many CAI women had been accustomed to "eating until stuffed"; few had critically examined their eating patterns before pregnancy. Those who had considered improving their diet had greater impetus during pregnancy when learning of health consequences. The majority of CAI women held the responsibility for food provision within the family and continued to cook foods in their cultural diet. Many also adopted Western patterns of eating, characterized by fast foods and carry out, due to convenience or struggling to cook while often balancing multiple jobs.

Women would express their commitment to changing these eating patterns and sometimes devising new strategies to cook healthy for the family. One woman who struggled to cook for her partner and three children proudly stated that she now batch cooks, leaves healthy snacks in the fridge ready to eat, and asserted "If you open my fridge you'll see nothing but fruits and vegetables!" (GDM, postpartum interview). Principal dietary changes included portion control, fewer carbohydrates, less soda, more vegetables, less prepared food, and a balanced plate with protein.

The pregnancy transition prompted mothers to critically reflect on their diet, demonstrating the constructs of a teachable moment. Specifically, mothers shifted how they related emotionally to food (emotion), improved understanding of foods' effect on their bodies (risk perception), and increased resolve to avoid undesired effects of unconstrained eating for themselves and their families (self-concept & social role). The teachable moment thereby results from a mother's deeply reflective self-evaluation, activation of a collective family role, and a heightened capacity and desire for change that characterizes the process of transformative learning.

DISCUSSION

We found that from the perspective of CAI women and their health care providers, pregnancy is a potent teachable moment for healthy eating promotion and diabetes prevention. The life course transition readily sparks mother's emotive capacity, redefines self-concept and social role, and increases risk perception for personal and family health. Most pregnant women showed tremendous receptivity to nutrition counseling and firm dedication to engage in lifestyle modification for themselves and for their baby. We recognize that what makes the pregnancy period *teachable* is largely what makes it *learnable;* with mother's receptivity and information-seeking a powerful driver.

Our exploration into the process of learning and health behavior change for CAI women may provide insight for providers to capitalize on pregnancy as a teachable moment. Our findings support the concept analysis positing that providers are instrumental in the creation of a teachable moment, and further sheds light on the process of co-creation.[60] Provider communication serves an influential and prominent role for CAI women who often begin to closely examine their diet and health in the clinic setting.

Effective teaching naturally hinges on the dynamics of learning. We considered what constitutes a learnable moment to support behavior change, and sought to identify characteristics that could render a teachable moment effective. Learners co- create knowledge and play an active, engaged role in transformation of ideas or perspectives. Receptivity is one element of learnability that is necessary but not sufficient for transformative learning. Openness to information (whether prompted by pregnancy or a disruption) sets the stage for basic learning, but the transformative learning that is more likely to result in behavior change necessitates critical reflection and change in self-concept.

Critical reflection is an essential construct in Mezirow's transformative learning theory, with learning capability shown as exercising reflective judgment, which in this case applied to dietary change and diabetes prevention behaviors for CAI women. Women engaging in critical reflection often evaluated their experience, typically reflecting on how their family's diet and health has changed since leaving their home countries. The transformative learning process involves 1) a disorienting or disruptive event (e.g., a "trigger" or cueing event) that challenges previously accepted knowledge; 2) questioning of assumptions and perspectives; and 3) discourse and dialogue through communicative learning.[128] CAI women's expressions of these components within in-depth interviews, accompanied by reflection, were taken as indications of such learning.

Specifically, the markers of learning within in-depth interviews appeared as women's critical self-reflection on their dietary patterns or lifestyle behaviors. If revision of habits of mind followed- that is, reconsidering prior belief systems - this marked the experience as transformative. In interviews with CAI women, altering habits of mind often manifested as reformulation of their lifestyles and recognizing the need to protect their baby or themselves through improvements in their diet or health. Women might subsequently state their commitment to change their diet or goals to prevent diabetes, beginning during pregnancy and often extending into the long-term.

Information-seeking served as one indicator of a learnable moment, though the process of critical reflection remains key to transformative learning. Through communicative learning, women often spoke with others in their social network about pregnancy-related health issues. Such discourse fosters learning that can alter one's self-concept, and one's relation with the social world; hence, the process of communicative learning is likely to become transformative.[128] This redefining of self-concept and social role importantly fits in as a construct of the teachable moment, marking the dialogical aspect of teaching and learning.

We therefore found Mezirow's transformative learning theory fitting for providing an explanatory framework for behavior change around a teachable moment – to elucidate how learning and teaching interconnect.[129] We posit that critical reflection to foster transformative learning must occur in order to achieve sustainable behavior change. Through critical reflection, CAI women learned about the importance of healthy eating for promoting the health and well-being of their families. Pregnancy served as a transitional cue for transformative learning through activation of the mother's social role, emotion, and risk perception around family health.

This qualitative study demonstrated the relevance of the teachable moment to all pregnant women– notably, irrespective of GDM status. As we expected, the majority of GDM women changed their diet, prompted by immediate risks and supported by nutritional counseling to manage their condition. We found that many CAI also share similar risk factors such as overweight, family history of diabetes, prior GDM, and co-morbidities. Early risk identification at the clinic led to earlier counseling to prevent pregnancy complications – which effectively increased receptivity to healthy lifestyle changes. Notably, many women without GDM also made changes or stated goals to eat healthier for weight loss or to manage diet-related comorbidities. Despite no prior risks, expectant mother's concern for providing good nutrition for the baby heightened their interest in healthy eating. Indeed, recent studies have demonstrated the influence of maternal diet on fetal outcomes; influencing the child's risk of overweight.[59]

Taken together, life course prevention of disease fosters lifelong health by setting into motion critical practices and perspectives. Pregnant women experience myriad influences on the household context and must accordingly reflect on how the new baby fits into the frame of family health. The dynamic process of household integration often empowers the mother to redefine her social role and assert her vision for the family's future. The mother as the "epicenter of the family," as one health care provider described, holds the power to transport the family with her toward positive changes. We believe these findings are transferable to non-Latina populations as well. While *familism* is a strong cultural value for Latina women, the motherhood or family transition is likely salient for all women redefining their social role. Providers thereby maximize the power of their counseling by taking advantage of the highly receptive time.

Strengths

This study has several strengths. It was devised from needs identified by a community clinic and implemented through a constructive academic-community collaboration with stakeholder triangulation. Methodological triangulation was achieved through use of qualitative and quantitative methods employing interviews with providers and CAI women, reviews of clinic charts, and a secondary analysis of the FQHC's first constructed prenatal dataset. Member checking to share and obtain feedback on preliminary findings with key providers and collaborators at Mary's Center enhanced the accuracy and depth of the analysis. In-depth interviews with CAI women generated insightful perspectives to aid with health communication in the clinic setting; in addition, women had an opportunity to express themselves and disclose emotional concerns that they may not often have space to release.

Limitations

We identified several limitations to this study. First, the follow-up interviews conducted at 3-6 months after birth of the baby may not capture a sufficiently long period of time to investigate the sustainability of dietary changes over the long-term. While these interviews were conducted after the postpartum period and allow for a more regular pattern of eating to be established, continued changes and stabilization may still occur during the transitional time. Future studies that can follow up with women a year or year and a half later may better assess the sustainability of their dietary changes. Second, we were able to follow up with only half of the women for a postpartum interview; there may be differences in the experiences of those who we were able to contact and who were willing to participate (e.g., barriers that hinder dietary or behavior change). Third, given the unique sociopolitical experience of CAI women, the transferability of the findings to other Latino groups and even non-Latina women may be limited.

Implications for Practice and Future Research

This perspective has several counseling implications. We found that providers systematically communicate health risks, yet less often cue powerful motivational drivers around the emotive and role changes that women experience during this transition. Providers may tailor counseling to factors that women identify as their motivation to make and sustain changes, using motivational interviewing – a powerful counseling style effective for health interventions that lends itself to critical reflection.[130-132] When providers elicit and activate women's own concerns (e.g., remaining healthy to see children grow up), they provide more effective counseling by increasing intrinsic motivation for behavior change. This provider-facilitated transformative learning engages women in a process of healthy lifestyle change during pregnancy that can continue over the life course.

While the existing clinic process effectively accounted for identification of those at highest risk, it underutilized the counseling opportunity. Given that the majority of CAI pregnant women in the clinic population were overweight and often exhibited additional risk factors, they could benefit from lifestyle counseling during pregnancy to prevent chronic diseases longer term. Since pregnancy is one of the few periods in the life course with high receptivity and frequent accessing of health services - particularly for this low-income and immigrant population - providers could considerably enhance the promising opportunity for behavior change.

Sustaining healthy eating changes over the long term likely necessitates that mothers undergo perspective transformation (See Figure 2). Our postpartum interviews suggest that sustainability hinges on three main factors: 1) Mothers extending their perspective beyond feeding in utero and breastfeeding to encompass feeding the child for life course growth and development; and 2) Mothers regarding healthy eating as a central

modality to promote health and well-being for herself, her family, or both (couched in the family diet) and 3) Mothers redefine self-concept and social role around collective rather than individual thinking (i.e., familism).

Provider counseling may support each of these three factors through continuity of care that employs positive reinforcement, accountability, and facilitates cumulative learning over repeated interactions to support progressive behavior change.

Future studies

Identifying teachable moments. While this study explored pregnancy as a teachable moment, other transitions in the life course may prompt healthy changes. Fundamentally, any pivotal transitional time that activates emotion and self-concept, along with associated health concerns, poses a potential receptive period conducive to intervention.

Relevant to the family transition, preconception care could signal another teachable moment around pregnancy to encourage women (and their partners) who are considering becoming pregnant to make healthy lifestyle changes. Some changes might include smoking cessation, healthy eating, and weight loss in preparation for a family. Other teachable moments that have been explored and suggestive of dietary change include diagnoses of chronic health conditions or illnesses such as cancer. Such events with high emotion and risk perception might lead people to make changes if they perceive diet to be causally linked to the condition. Transitions for teenagers mark pivotal times for lifestyle change, such as leaving home for college or living independently on their own for the first time. Teen and even child programs that incorporate cooking skills may help build self-efficacy. Early teachable moments in the life course may be highly influential for establishing diverse tastes or facilitate formation of new habits. Even babies can acquire taste preferences when flavors from the mother's diet are transmitted through amniotic fluid.[133] Childhood

teachable moments may introduce a variety of foods and vegetables, lower intake of processed and sugary foods, and reinforce healthy portion sizes to facilitate life course healthy eating. Moreover, when mothers initiate lifestyle changes, as described in this study, role modeling and direct influence on food provision may correspondingly translate into a teachable moment for the children and family.

Expanding delivery modes. While health care providers hold an influential counseling position, other modes of delivery may also be effective in creating a teachable moment or in reinforcing provider messages. The creation of a teachable moment may be simultaneously facilitated or hindered by communicative learning within the social network. Future studies could explore multiple sources of dietary influence– such as partners, mothers, mothers-in-law, friends, and peers who share food culture and recommendations, and their varying degrees of influence. Supportive services offered by the FQHC included social services and home visiting nurses, which aid with reaching a low-income population that often faces additional barriers in access to care. Outside of the clinic, community engagement through outreach and peer networks may serve as an important point of care. Social media has become an increasingly feasible communication mode using digital platforms. Given CAI women's substantial media engagement, it is worthwhile to explore the teachable moment outside of the clinic setting using mobile health technologies. These create opportunities for tailored communication, self-monitoring, as well as periodic prompts to facilitate continuous engagement in healthy behavior change.

Conclusions

This paper presents a promising framework to enhance health communication around healthy eating promotion. With the rise in global non-communicable chronic disease

in recent decades, championing a life course family health perspective has potential to reduce health disparities and improve generational outcomes. An acculturating diet of Central American immigrants – one that adopts convenience foods and Western dietary patterns- has contributed in part to the steady emergence of childhood obesity and earlier manifestation of diabetes.[16] Capitalizing on the teachable moment during pregnancy may serve as a powerful strategy to achieve lifetime and intergenerational change needed for chronic disease prevention.

We may accordingly help families "continue the chain of happiness and tranquility," as one mother pronounced her hope of transmitting health to her children, and then on to their children.

Acknowledgements

We gratefully acknowledge research support from the Johns Hopkins University Department of Health, Behavior and Society doctoral dissertation award, and the Center for a Livable Future-Lerner pre-doctoral fellowship.

APPENDIX

Figure 1: Conceptual Model for Pregnancy as a Teachable Moment for Dietary Change and Diabetes Prevention

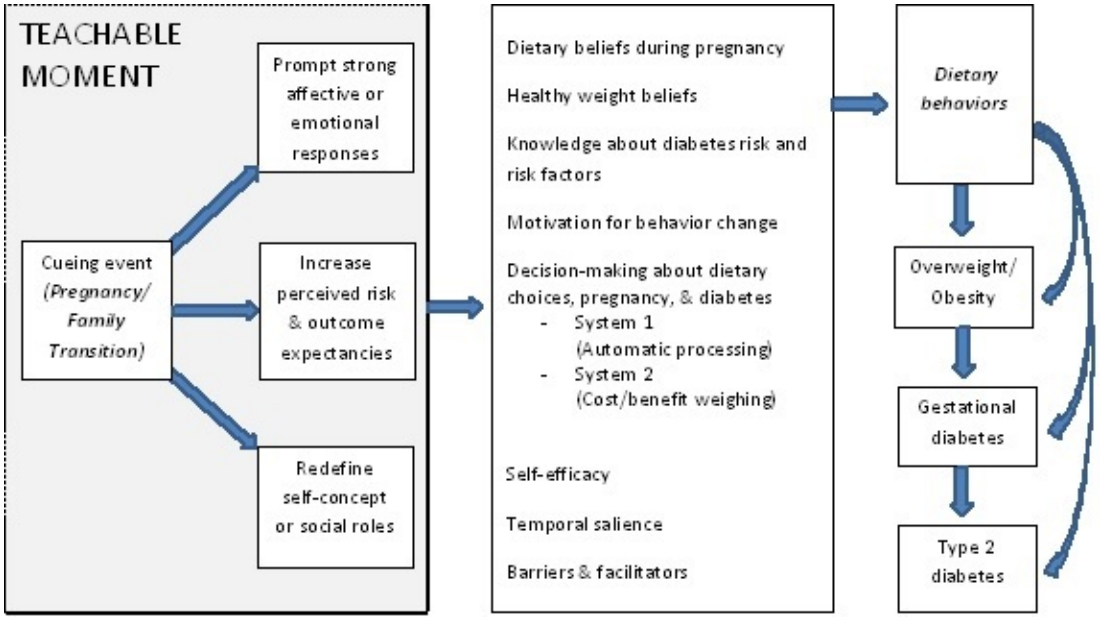
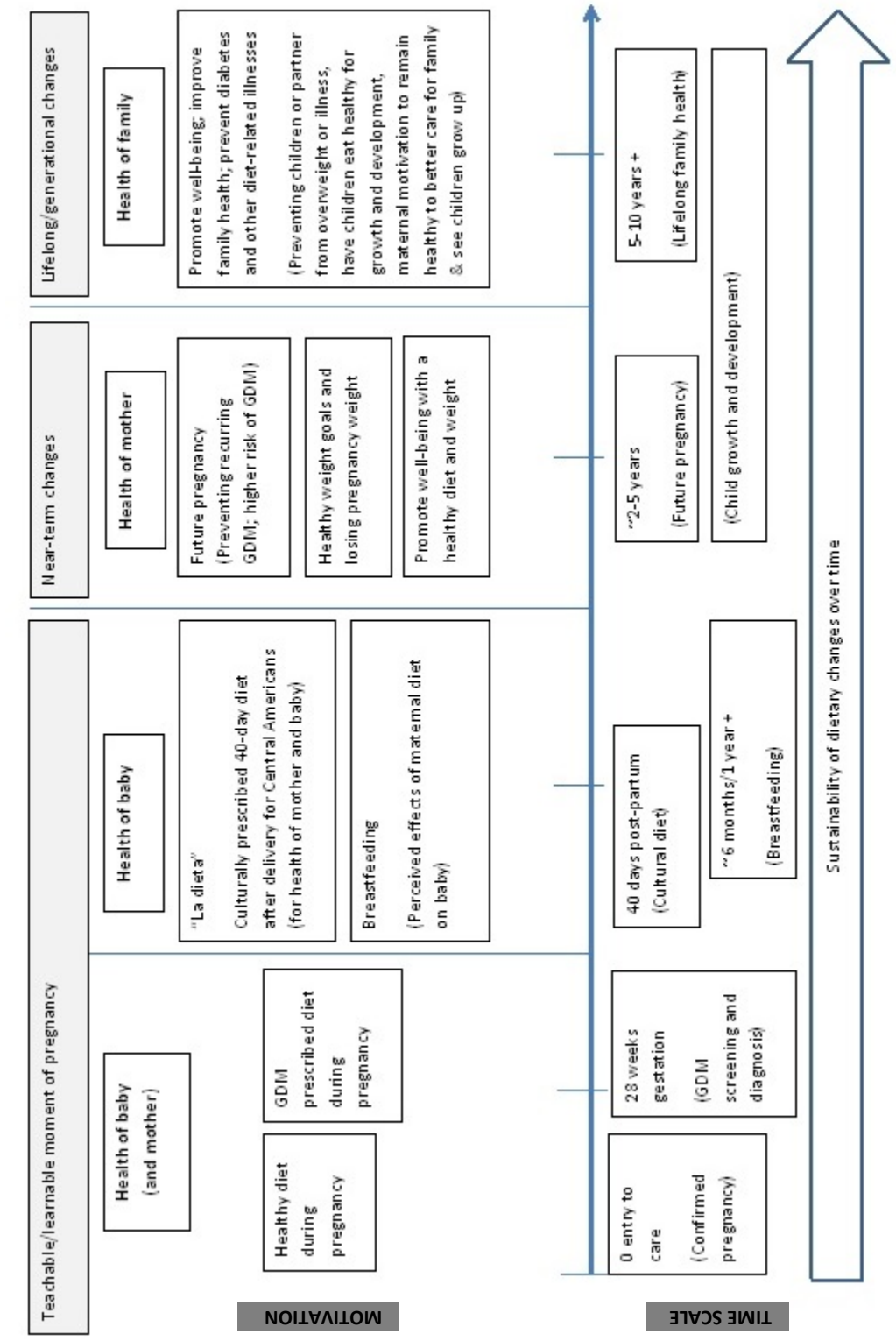


Figure 2: Motivation and Sustainability for Pregnancy as a Teachable Moment



REFERENCES

1. Who J, Consultation FE. Diet, nutrition and the prevention of chronic diseases. World Health Organ Tech Rep Ser. 2003; **916**(i-viii).

2. World Health Organization. Global report on diabetes. Geneva; 2016.

3. Hall PA, Fong GT. Temporal self-regulation theory: A model for individual health behavior. Health Psychology Review. 2007; **1**(1): 6-52.

4. Sniehotta FF, Presseau J, Araújo-Soares V. Time to retire the theory of planned behaviour. Health Psychology Review. 2014; **8**(1): 1-7.

5. McBride CM, Emmons KM, Lipkus IM. Understanding the potential of teachable moments: the case of smoking cessation. Health Educ Res. 2003; **18**(2): 156-70.

6. Chasan-Taber L. Physical activity and dietary behaviors associated with weight gain and impaired glucose tolerance among pregnant Latinas. Adv Nutr. 2012; **3**(1): 108-18.

7. Zong J, and J. Batalova. Central American Immigrants in the United States. 2015 [cited 2016 Feb 22]; :[Available from: http://www.migrationpolicy.org/article/central-american-immigrants-united-states

8. Caballero B. The global epidemic of obesity: an overview. Epidemiologic reviews. 2007; **29**(1): 1-5.

9. Webster R, Heeley E. Perceptions of risk: understanding cardiovascular disease. Risk Manag Healthc Policy. 2010; **3**: 49-60.

10. Darnton-Hill I, Nishida C, James WP. A life course approach to diet, nutrition and the prevention of chronic diseases. Public Health Nutr. 2004; **7**(1A): 101-21.

11. Dixon B, Pena MM, Taveras EM. Lifecourse approach to racial/ethnic disparities in childhood obesity. Adv Nutr. 2012; **3**(1): 73-82.

12. Elder GH. The life course as developmental theory. Child Development. 1998; **69**(1): 1-12.

13. Ben-Shlomo Y, Kuh D. A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. Int J Epidemiol. 2002; **31**(2): 285-93.

14. Phelan S. Pregnancy: a "teachable moment" for weight control and obesity prevention. Am J Obstet Gynecol. 2010; **202**(2): 135 e1-8.

15. Monte S, Valenti O, Giorgio E, Renda E, Hyseni E, Faraci M, et al. Maternal weight gain during pregnancy and neonatal birth weight: a review of the literature. J Prenat Med. 2011; **5**(2): 27-30.

16. Mantzari E, Vogt F, Marteau TM. The effectiveness of financial incentives for smoking cessation during pregnancy: is it from being paid or from the extra aid? BMC Pregnancy Childbirth. 2012; **12**: 24.

17. Coa KI, Smith KC, Klassen AC, Caulfield LE, Helzlsouer K, Peairs K, et al. Capitalizing on the "teachable moment" to promote healthy dietary changes among cancer survivors: the perspectives of health care providers. Support Care Cancer. 2015; **23**(3): 679-86.

18. Szwajcer EM, Hiddink GJ, Koelen MA, van Woerkum CMJ. Nutrition awareness and pregnancy: Implications for the life course perspective. European Journal of Obstetrics & Gynecology and Reproductive Biology. 2007; **135**(1): 58-64.

19. Szwajcer EM, Hiddink GJ, Koelen MA, Woerkum CMJ. Nutrition-related information-seeking behaviours before and throughout the course of pregnancy: consequences for nutrition communication. Eur J Clin Nutr. 2005; **59**.

20. Murguia M. Machismo, marianismo, and hembrismo, and their relationship to acculturation as predictors of psychological well-being in a Mexican and Chicano population: University of Wisconsin--Madison; 2001.

21. Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, Damm P, et al. International association of diabetes and pregnancy study groups recommendations on the

diagnosis and classification of hyperglycemia in pregnancy. Diabetes Care. 2010; **33**(3): 676-82.

22. Ferrara A. Increasing prevalence of gestational diabetes mellitus: a public health perspective. Diabetes Care. 2007; **30 Suppl 2**: S141-6.

23. Karakosta P, Alegakis D, Georgiou V, Roumeliotaki T, Fthenou E, Vassilaki M, et al. Thyroid Dysfunction and Autoantibodies in Early Pregnancy Are Associated with Increased Risk of Gestational Diabetes and Adverse Birth Outcomes. J Clin Endocrinol Metab. 2012.

24. Bellamy L, Casas JP, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. Lancet. 2009; **373**(9677): 1773-9.

25. Kim C, Newton KM, Knopp RH. Gestational diabetes and the incidence of type 2 diabetes: a systematic review. Diabetes Care. 2002; **25**(10): 1862-8.

26. England LJ, Dietz PM, Njoroge T, Callaghan WM, Bruce C, Buus RM, et al. Preventing type 2 diabetes: public health implications for women with a history of gestational diabetes mellitus. Am J Obstet Gynecol. 2009; **200**(4): 365 e1-8.

27. Ferrara A, Ehrlich SF. Strategies for diabetes prevention before and after pregnancy in women with GDM. Curr Diabetes Rev. 2011; **7**(2): 75-83.

28. Ritchie J, Spencer, L. Qualitative data analysis for applied policy research. In: Bryman A, Burgess, R., editor. Analysing qualitative data. London: Routledge; 1993. p. 173–94.

29. Lawson PJ, Flocke SA. Teachable moments for health behavior change: a concept analysis. Patient Educ Couns. 2009; **76**(1): 25-30.

30. Mezirow J. Transformative learning: Theory to practice. New directions for adult and continuing education. 1997; **1997**(74): 5-12.

31. Phelan S, Hart C, Phipps M, Abrams B, Schaffner A, Adams A, et al. Maternal behaviors during pregnancy impact offspring obesity risk. Exp Diabetes Res. 2011; **2011**: 985139.

32. Christie D, Channon S. The potential for motivational interviewing to improve outcomes in the management of diabetes and obesity in paediatric and adult populations: a clinical review. Diabetes Obes Metab. 2014; **16**(5): 381-7.

33. Lundahl B, Moleni T, Burke BL, Butters R, Tollefson D, Butler C, et al. Motivational interviewing in medical care settings: a systematic review and meta-analysis of randomized controlled trials. Patient Educ Couns. 2013; **93**(2): 157-68.

34. Emmons KM, Rollnick S. Motivational interviewing in health care settings. Opportunities and limitations. Am J Prev Med. 2001; **20**(1): 68-74.

35. Mennella JA, Jagnow CP, Beauchamp GK. Prenatal and postnatal flavor learning by human infants. Pediatrics. 2001; **107**(6): E88.

36. Sussner KM, Lindsay AC, Greaney ML, Peterson KE. The influence of immigrant status and acculturation on the development of overweight in Latino families: a qualitative study. J Immigr Minor Health. 2008; **10**(6): 497-505.

I. MANUSCRIPT 3

TITLE: Health communication strategies for preventing gestational diabetes for health organizations serving Central American immigrants (CAI)

INTRODUCTION:

With the rise of obesity worldwide, the incidence of gestational diabetes mellitus (GDM), has correspondingly increased and poses a substantial public health burden.[134] In the United States, GDM is the most common pregnancy complication, affecting 7% to 18% of pregnant women.[2, 134] Defined as onset or first recognition of abnormal glucose tolerance during pregnancy, GDM can result in adverse maternal and fetal outcomes in the short and long term.[1, 2] Notably, women who have had GDM face a seven-fold increased risk of developing Type 2 diabetes mellitus (t2DM) in the future; an estimated 20-60% of gestational diabetics develop t2DM in the 5-16 years post-pregnancy.[6, 7] The high-risk period during and after pregnancy therefore signals a critical time for lifestyle modification to reduce the incidence of GDM and t2DM.[8, 9] Given the high economic and health costs from diabetes, preventing the conversion of GDM to diabetes has been identified as a priority area for gestational diabetes research.[10] Moreover, Latina women in the US have a higher risk of GDM compared to non-Latina whites, and have also been found to have the highest rates of increase of GDM from 2000-2010.[135] These trends signal the need for particular attention to Latinas in the United States who suffer disproportionately from GDM while underutilizing prenatal care.[102]

Women with GDM are counseled to manage the condition primarily by following a diabetic diet during pregnancy; some women also take medication.[113] Dietary counseling for

GDM extends to both prevention of GDM, if initiated early in pregnancy, and to management of the condition.[136] There is a need for greater understanding of dietary counseling for Latina women with GDM. Few studies, however, have investigated health communication strategies for Latina women to aid with this objective.

Despite great need, behavioral research has yet to identify effective strategies for sustained dietary modification over the long-term to prevent chronic illnesses such as diabetes, which may necessitate novel behavioral science and interdisciplinary approaches.[49, 137] Research on primary prevention for low-income Latinos, who experience higher risk for diabetes compared to non-Latino whites, may significantly reduce suffering from this debilitating condition.[106] However, research on Latinas and GDM has been minimal and there is need for studies for low income minorities that address the challenge of chronic disease prevention.

One strategy we explore is the concept of a teachable moment, which refers to an event or circumstance in an individual's life, often a naturally occurring life transition, which may motivate individual adoption of risk-reducing behaviors.[55, 125] Researchers have posited pregnancy to be a teachable moment for obesity prevention and weight control considering the mother's potentially heightened receptivity and motivation to improve her and her baby's health, as well as the increased likelihood of clinical contact during that period and the opportunities for intervention it presents.[34, 56] We extend this notion to investigate pregnancy as one teachable moment for healthy eating promotion and diabetes prevention over the life course.

During pregnancy, the constructs of a teachable moment- risk perception, emotion, and redefining self-concept and social roles – may be highly salient for expectant mothers (See Figure 1). Specifically, McBride posited teachable moments as cueing events that: 1)

increase perceptions of personal risk and outcome expectancies; 2) prompt strong affective or emotional responses, and 3) redefine self-concept or social roles.[55] Emotion and self-concept may be highly present during the transition of pregnancy – activating a role that is profoundly emotional in its frequent coupling of excitement and anxiety. Risk perception may increase for expectant mothers concerned for their own and their baby's health, and may subsequently prompt adoption of healthier behaviors.

Health care providers who deliver a consistent source of counseling for prenatal women may be instrumental in the creation of a teachable moment.[60] Moreover, health communication with Latino populations in the United States should necessarily take into account values of cultural importance. In the Washington DC metropolitan region, the Central American immigrant (CAI) population - mainly from El Salvador, Guatemala, and Honduras- comprises the largest Latino subgroup and continues to grow.[109] There is need for more research that differentiates among Latino subgroups given that the unique Central American immigrant sociopolitical experience, as well as potential economic and health differences, will guide approaches to health care for this group.[100, 107] We therefore qualitatively explore health communication among CAI women and their health care providers around healthy dietary change during pregnancy for GDM prevention and management. We sought as well to generate implications for the prevention of future diabetes. To our knowledge, this is the first study to investigate health communication strategies with Central American immigrants who develop GDM during pregnancy.

To address these research gaps, we conducted qualitative interviews with providers and CAI women seeking prenatal care at Mary's Center, a large Federally Qualified Health Center in Washington DC serving thousands of prenatal women yearly, many of whom emigrated from Central American countries. The Mary's Center clinic estimates that 17% of

their pregnant Latina women develop GDM, which is the most common pregnancy complication. Among GDM women in the clinic, approximately two-thirds are diet-controlled while one-third use a combination of diet-control and medication.

It is important to understand health communication around gestational diabetes and healthy eating during pregnancy given 1) the integral role of nutrition in pregnancy; 2) the role of diet in managing GDM; and 3) the importance of dietary changes after the prenatal period to prevent future diabetes. In this study, we sought to identify effective health communication for dietary change during pregnancy, as well as to explore novel and culturally tailored strategies to assist women in sustaining healthy changes over the long-term.

We thereby conducted in-depth interviews to address the following two aims:

1) To explore the concordance of perspectives among Central American immigrant (CAI) women and their health providers to inform counseling around gestational diabetes to facilitate culturally competent care.

2) To identify health communication messages and strategies around pregnancy as a teachable moment that may aid healthy eating during pregnancy and over the life course to prevent diabetes and diet-related chronic illness.

METHODS:

We conducted a qualitative study comprised of in-depth interviews with health care providers and pregnant and postpartum CAI women, and prenatal chart reviews.

Setting

We formed an academic--community collaboration and conducted the research at Mary's Center, a large Federally Qualified Health Center (FQHC) in Washington, D.C. that provides maternal and child care services to participants regardless of their ability to pay. We drew the sample of providers and CAI women accessing prenatal services from the DC site. Approximately 75% of the prenatal population are Central Americans; half are obese and experience high rates of GDM.

Study sample

The sample of pregnant women comprised low-income, urban immigrant Central American adults accessing prenatal services at the FQHC, with the following inclusion criteria: ages 18-45 years old, tested for GDM, at least 28 weeks gestation, and not having health or lifestyle factors that would make participation a burden. We followed up with the same women for postpartum interviews approximately 3-6 months after delivery. We purposively sampled CAI women using critical case and maximum variation sampling, to generate a case study sample of GDM and non-GDM sub-samples with each representing a diversity of characteristics (i.e., age, parity, family history, risk factors) to allow for richer exploration of relevant themes.

Health care providers (ages 18 and older) were purposively sampled based on the frequency and relevance of their communication with pregnant patients about diet, diabetes, and health. These included: obgyns, nutritionists, WIC nutritionists, nurses, midwives, case managers, and care coordinators - reflecting the coordination of care at the clinic.

The final sample of in-depth interviews (IDIs) comprised: 13 IDIs with providers, 20 IDIs with pregnant women (10 GDM; 10 non-GDM), and 10 IDIs with postpartum women (7 GDM; 3 non-GDM). Data collection spanned one year from March 2014-February 2015. The

majority of provider interviews was conducted prior to interviews with CAI women, and informed the questions and context of the latter interviews.

Data collection procedures

All participants were enrolled using Johns Hopkins University IRB-approved recruitment and informed consent forms. Consents were signed immediately prior to conduct of the interview. Interviews were primarily conducted in the clinic; with some follow-up interviews conducted at a convenient location of the participants' choosing (e.g., library, home). As compensation for their time, all participants were offered USD 20 after the interviews.

Interviews lasted approximately 60-90 minutes and were audio recorded. All provider interviews were conducted in English and transcribed verbatim by the student researcher (KL). CAI interviews were conducted in Spanish (with the exception of one in English with a bilingual participant) by the bilingual student researcher. CAI interviews were transcribed verbatim by native Spanish speakers and reviewed by the researcher for completeness and accuracy.

The student researcher conducted chart reviews after initial interviews with CAI women to obtain information on the clinical and behavioral context (e.g., risk factors, diet, and GDM management).

Data analysis

We analyzed the qualitative data using the framework method developed by the Social and Community Planning Research Institute.[94] We conducted a cross-case analysis between the two sub-samples of patients who developed GDM and those who did not. The student researcher developed the codebook inductively beginning with open coding on a

subset of interviews, and then deductively added existing themes from the interview guide. The codebook was refined with a native Spanish speaking research assistant (CG) by discussing definitions and interpretation of themes applied to a subset of interviews. The student researcher thematically coded provider and patient interviews using Atlas.ti 6.1 qualitative analysis software (Berlin, Scientific Software Development). The same codebook was applied to both sets of interview data.

The student researcher conducted the indexing (coding) and analysis in Spanish to retain the meaning, context, and idiomatic expressions. During this analytic phase, KL and CG met consistently to discuss linguistic and cultural interpretations of the interview data.

We organized the findings by high, moderate, and low concordance of themes between CAI women and their providers. Concordance refers to the overlap in perspectives among CAI women and their health care providers. We chose the term "concordance" rather than "agreement" since concordance might have a less value-laden connotation compared to agreement (e.g., construed as "agreeing" with providers).

First, **high concordance** themes referred to themes of high coverage and similar perspectives among pregnant CAI women and their providers. Specifically, both providers and CAI women commonly spoke about these themes and expressed similar perspectives. High concordance themes represent opportunities to reinforce health promoting attitudes and behaviors particularly to support long-term sustainability. Second, **moderate concordance** themes referred to themes of moderate coverage or variable perspectives among pregnant CAI women and their providers. Themes of moderate coverage could mean that strategies were less commonly expressed across providers, or that fewer CAI women spoke explicitly of them. Given that specific strategies were not asked of each of the interviewees in the in-depth interviews, the frequency or number of mentions does not

correspond directly to existence of or receptivity to these views by providers or CAI women. Moderate concordance was thereby assessed as a composite of commonality of themes with the degree of content overlap in perspectives. Moderately concordant themes should be considered potentially beneficial strategies, many of which highlight what appears effective for that person but may not generalize to all women. Thirdly, **low concordance** themes referred to themes of low coverage or differential perspectives among pregnant CAI women and their providers. These represent themes where women either had difficulty grasping certain concepts (e.g., future risk of illness), or providers could have missed a counseling opportunity or not fully picked up on CAI women's motivation for change. Low concordance themes represent opportunities for providers to deliver basic health education messages and then tailor them to emerging concerns discerned through conversations with CAI women. For instance, limited or no discussion of a particular theme from providers (or vice versa from CAI women) would indicate low concordance, as would differing perspectives expressed by both parties on that theme.

RESULTS:

We present results in three sections of high, moderate, and low concordance of CAI women's perspectives and their providers. Selected quotes and their corresponding implications are included in accompanying tables that map on to each of the numbered sections below (see Tables 1, 2, and 3).

Section 1. High concordance of CAI women's perspectives and provider perspectives (Table 1)

In Section 1 we represent themes with high concordance - high coverage and similar perspectives - between pregnant CAI women and their providers. These represent opportunities to reinforce health promoting attitudes and behaviors for long-term

sustainability. Providers who integrate positive reinforcement with continuity of care may help women to sustain healthy changes through accountability and consistent support.

1.1 Capitalize on pregnancy transition to motivate mothers: *"They are more receptive to change because they are changing already."*

When asked directly about the potential of pregnancy as a teachable moment for healthy eating, the majority of providers expressed strong support for the concept. They provided examples of their participants' making healthy lifestyle changes during pregnancy, believing them to be more receptive due to strong concern for their baby. One provider stated "…it's a time when they are more receptive to change because - they are changing already. Their body is changing, their life is changing." Expectant mothers cited "love for the baby" as their motivation for behavior change to have the best health for themselves and the baby. As one mother with GDM acknowledged, "I started to take them [changes] more seriously since I am pregnant again because I want everything to go well for me…if I am well my baby will be too. If I don't take care of myself there is a risk that I can pass something to my baby."

While providers noted expectant mothers as more receptive to making healthy changes, some expressed uncertainty as to the best way to incorporate healthy eating counseling into prenatal care. Some providers felt that fitting in comprehensive nutrition counseling during visits might be difficult, given the many medical items to address during prenatal visits. Most agreed that a coordinated team approach would be ideal, and cited referrals to health promotion as critical for more extensive consults that would provide tailored support for nutrition education while serving to reinforce care plans.

1.2 Emphasize influence of maternal nutrition on the baby's health: *"What I am eating, my baby is receiving"*

Providers supported healthy eating changes for women during pregnancy by primarily counseling on healthier preparation of foods, eating less processed foods, cooking more vegetables, drinking more water and less sugar sweetened beverages, and eating a balanced plate of protein, fruits, and vegetables and grains. Providers additionally counseled gestational diabetics to reduce sugar and carbohydrate intake. As one provider described her experience, "There are exceptions, but if you tell them it's gonna be good for the baby, they will say ok, I'm going for it. So it's more easy for me to talk about portion control with pregnant women."

The majority of pregnant CAI women perceived a direct link between the foods eaten and what nourishes the baby, and sought to make better nutritional choices. One pregnant woman without GDM noted changes she made: "I imagine that what I am eating, my baby is receiving it. If I eat bad foods, he will receive bad foods." In addition, gestational diabetics were highly receptive to dietary changes during pregnancy for fear of complications, namely delivering a large baby, having the baby predisposed to diabetes, or needing to have cesarean section and surgery. One GDM woman linked her diet to potential effects on the baby, "The diet –if I am not on it – it's no more than if I say: 'I don't care, I am going to eat a lot of…sweets…a lot of sweet bread'… Then, in the future, when my son is born, he can be very large, or he can be diabetic…If I don't take care at this moment in time." Women therefore made strong links between diet during pregnancy and what their baby eats, which facilitated provider counseling to guide healthy dietary change.

1.3 Activate social role to safeguard family health: *"If you care about your family, you will not want them to be sick."*

CAI women often internalized guarding the family's health as a large part of their role. Many expectant mothers reported making lifestyle changes for the well-being of her

family, to result in "fewer illnesses and visits to the clinic." Providers sought to reframe mother's thinking of the diabetic diet, conveying that "…'This isn't just you who this nutrition we're talking about, this is for everyone…this is healthful eating, this isn't just a diet'." Prioritizing wellness often meant involving the whole family in lifestyle changes and creating a culture of health. As one provider described, "... this is in the diet for the kid, we need to all eat the same to be a good example."

Many CAI women spoke of the importance of ensuring the family's health, for instance, "The important thing when one is cooking is to think not only of yourself but the whole family as well, because if you care about your family, you will not want them to be sick." The mother's motivation often centered on her dedication to her perceived role; providers explained that mothers wanted a healthy life, not to suffer, and wanted to be there for their children once they grow up. Providers recognized that CAI women were highly committed to the care of their kids and saw that as a way to "steer them into" or motivate them to change food patterns.

1.4 Apply a strength-based approach with motivational interviewing: *"Recognize the skills that they have"*

Providers used motivational interviewing techniques and a strength-based approach to help women recognize strategies that have worked for them and to identify attainable goals. The process of building women's self-efficacy for healthy eating also empowers CAI women who face challenges from low social and economic resources. One provider described how she highlighted small successes: "Wow, tell me how you did that?! And really building off of the skills that *they* have in helping to…help *them* to recognize the skills that they have and times when they *have* had successes. And it's very basic motivational interviewing."

Another provider explained that she tries "to move them slowly to change behaviors and to agree with the changes that they want to make, like trying to make their own – like coming from them." Providers explored barriers together with their participants and asked them to identify solutions and ways to begin taking new steps. They aimed to help women increase self-efficacy for healthy eating through experiencing small successes, and to build on what has been going well. One woman expressed: "Now I am used to it. I don't drink soda. I thought that I wouldn't be able to do it…Before I became pregnant with her I was super fat and I didn't want to be that way this time."

Section 2. Moderate concordance of CAI women's perspectives and provider perspectives (Table 2)

In Section 2 we represent themes with moderate concordance - moderate coverage or variable perspectives - between pregnant CAI women and their providers. Themes of moderate coverage could mean that strategies were less commonly expressed across providers, or that fewer CAI women spoke explicitly of them. Given that specific strategies were not asked of each of the interviewees in the in-depth interviews, the frequency or number of mentions does not correspond directly to existence of or receptivity to these views by providers or CAI women. Moderately concordant themes should be considered potentially beneficial strategies, many of which highlight what appears effective for that person but may not generalize to all women.

2.1 Make progressive changes over multiple pregnancies: *"I've been talking about diet for the last 3 babies"*

Many CAI women noted dietary changes they had made over time, sometimes over the course of several pregnancies. One woman shared her success in reducing soda intake – "I couldn't when I had my son but now with my daughter coming I have to do it." They

described progressive efforts to make healthier changes at each pregnancy, which suggests that each pregnancy opens up another window for behavior change.

Providers could capitalize on the expectant mother's renewed motivation and receptivity during each pregnancy transition. One provider noted her approach: "So you can continue to work on this through multiple pregnancies…I've had some I've been talking about diet for the last 3 babies…some have actually followed their diet better, and lost some weight." The teachable moments that occur during prenatal care may help women to gradually achieve lifestyle modification.

Providers identified continuity of care as one important aspect in helping women begin or persist with healthy changes, "like if we see those patients during the pregnancy and definitely after and one year after…and we kind of *go back* to the risk factors and *bring* those memories back." When establishing trust and a relationship with the same provider, accountability and positive reinforcement can become effective tools for supporting behavior change.

2.2 Foster women's resolve to prevent or delay diabetes: *"You can prevent diabetes when you eat healthy"*

For CAI women, their prior experiences with GDM, or the salience of comorbidities including overweight or diabetes for themselves or family members, motivated them to continue healthy lifestyle changes postpartum. One woman affirmed "…you can, not sure if it's 100%, but you can prevent it; you can prevent diabetes when you eat healthy."

Some women also mentioned the hereditary nature of diabetes, stating that they were more likely to develop diabetes if their parent or first degree relative had it. One woman reflecting on heredity and her own lifestyle stated "Well I carry risk because of my

mother, since I can inherit it. Therefore, I have to take care of myself from now on." CAI women who had observed family members suffering from diabetes related more tangibly to the condition, feared it as a serious and debilitating illness, and wanted urgently to stave it off.

Some CAI women spoke of spirituality, voicing expressions such as "I ask God for everything to go well" and "hopefully God doesn't want me to have it." Their spiritual expressions of hope, however, did not suggest a fatalistic view of diabetes or an external locus of control. Rather, CAI women's spiritual faith appeared to coexist with and bolster their will to achieve health promotion goals and prevent chronic illness. Many women exhibited high determination to eat healthy and engage in physical activity to keep diabetes away, which largely reflected the guidance and information on prevention they had received from providers.

Providers did not speak of spirituality, but rather of heredity, diet, exercise and weight as factors in women's risk of diabetes. They conveyed the importance and effectiveness of lifestyle modification to prevent or delay future diabetes. While providers did not state that diabetes was 100% preventable, they sought to foster women's self-efficacy for prevention by supporting goal-setting to improve their and their family's health.

2.3 Link healthy eating and physical activity to a healthy weight: "To have good health, one needs to exercise and eat healthy."

For many CAI women, increased weight over the years from pregnancy weight retention and lifestyle served as a powerful motivator to make healthier eating and physical activity changes for their overall health. Both GDM and non-GDM women expressed concerns over their weight status, voicing dismay over accumulated weight gain over the years. These concerns became more salient during pregnancy due to potential

complications such as GDM or simply through women's experiencing gestational weight gain and anticipating the need for weight reduction postpartum. When mothers experienced or internalized risk of overweight or diet-related illnesses (e.g., hypertension, high cholesterol, anemia), they exhibited greater motivation to initiate or maintain healthy eating changes.

Many CAI women who expressed a desire to lose weight stated postpartum goals to renew or increase their commitment to lifestyle changes once their baby is born. One woman expressed her motivation: "I would like to exercise because I want to maintain a normal weight and it is better for my health. In order to have good health, one needs to exercise and eat healthy."

Many overweight women – even those without any manifested weight related comorbidity - also expressed the strong desire to lose weight, having noticed ranges of 10-30 pounds of weight gain over recent years and often over multiple pregnancies. Their negative evaluation of weight changes appeared in part to influence their self-concept and self-esteem, since some women reflected on previously being thin and noted how their higher weight now affected them. Principal reasons women cited for wanting to return to their previous, lower weight included improving daily functioning, overall well-being, preventing long term chronic illness, and restoring energy levels to care for themselves and their households better.

While providers did not advise that women lose weight during pregnancy, under the consideration that women needed to be gaining weight for the baby, they did counsel on healthier lifestyle behaviors (e.g., taking short walks to manage stress or anxiety and increase activity). Providers appeared to view the postpartum period rather than pregnancy as a time for guidance on weight reduction; however, anticipatory guidance during

pregnancy may help women to manage both gestational weight gain and formulate postpartum weight loss goals. Setting in place healthy lifestyle patterns may address women's anxiety as well as capitalize on their motivation for future weight loss.

2.4 Involve family members in lifestyle changes: *"The two of us we are the same…we are overweight"*

Some providers intervened with other family members to make healthy lifestyle changes, particularly when CAI mothers identified family-level barriers to change. Strategies implemented have been bringing in the partner or mother-in-law to a clinic visit, and encouraging the partner to take walks with the mother for diabetic control. One mother whose five year old daughter was becoming higher in weight decided to take daily walks together, pronouncing that both of them shared the same experience of being overweight, and "That's why I want to lose weight and for her to lose weight and it's good for me to walk."

While providers shared accounts of male partners of the overall clinic population who resisted women's changing the family diet, the CAI mothers interviewed did not reveal fathers' opposition to healthy eating changes. CAI women largely stated that fathers of the baby wanted their children to grow up healthy and supported healthy dietary changes for the mother. As one mother described "He [partner] tells me that if we eat healthier then we won't get sick, because what I eat, I give to them [the family] as well." Some CAI women noted that their partners had been developing comorbidities such as hypertension and therefore simultaneously sought to improve their own health. These added motivations make the prenatal and postpartum period a conducive time for jointly making lifestyle changes. Some women, however, identified challenges from mothers-in-law to change the family diet; provider counseling could take this influential role into account.

Providers who spoke with women about the context of household food better understood the social experience of eating. One provider described a 16 year old GDM whose "…typical breakfast was a few cups of coffee and some sweet pastries with her mother. So this was their bonding time." Notably, the social context of eating draws upon more than simply personal health or habits. The family diet holds a shared meaning particularly for immigrants who are separated from much of their extended family. Effective recommendations therefore address eating and meals at the family level, and may involve mother and daughter, or spouses or partners.

2.5 Cultivate life course nutrition for the child: *"They have to eat to live and not live to eat"*

Mothers optimize children's nutrition if they extend the notion of feeding the baby to cultivating healthy eating patterns for the child over the life course. One provider expressed that while mothers make changes during pregnancy for the baby, "…if they put the same commitment after the baby is born, that's total gain for all of us…"

Pediatrician counseling notably emerged as a powerful source of motivation for women to make healthy changes for the family. Mothers became concerned when pediatricians alerted them that their children had become overweight or were showing high cholesterol; several mothers cited such alarms as a trigger to take walks with their children or instill healthier changes in the household diet. As one mother asserted regarding her daughter, "I've been stopping this manner of eating and it is good for her, because she has gained weight because of that and I don't want her to get sick like me!"

Some providers called upon one important social role of parents to not only *feed* the whole household healthier foods but also to *teach* children good nutritional habits that can

last over their lifetimes. As one provider explained: "Nutrition is one of those really important jobs that we have as parents…we can teach our kids how to eat well…"

Some mothers similarly discussed their social role to teach children to have a healthy and balanced relationship with food. One mother wished to convey to her children "that they have to eat to live and not live to eat. One has to form these ideas in them because they love to eat, and I understand because I come from a family that likes to eat a lot." Cultivating life course nutrition for the child could encompass a broader perspective of teaching children to eat healthy and to sustain those habits over their lives.

2.6 Illustrate cost of prevention vs. real cost of illness: *"What does it cost to be sick?"*

Providers framed the relatable, tangible costs of prevention vs. becoming ill to elucidate the true cost of being sick. Providers sought to help diabetic participants imagine the emotional, financial, and lifestyle consequences of chronic illness, while taking into account the socioeconomic challenges in women's lives. Given CAI women's existing barriers including time and resource constraints, the prioritization and valuation of healthy eating might not always exist at the forefront of their minds. However, providers aimed to put prevention into context and explain the true cost of having diabetes or another chronic condition. For instance, one provider conveyed "Imagine, yes this does feel like an added cost, but the reality is it's probably 10 or 15 dollars, and what does it cost to be sick? And you can't watch your *grandchildren* because you're not able to get up, or you're in the hospital."

CAI women who considered their health in this context had greater motivation to purchase and adhere to medication, increase exercise, or make efforts to cook healthier foods to prevent long-term debilitating consequences. One woman cited her motivation to

make healthy changes as "for one's health and thinking about two kids…If I don't take care of my cholesterol it can fill my arteries, my heart can stop and I will no longer even reach fifty years old."

Providers who reframed the types of costs based on the reality of women's salient concerns aided decisional balance for self-management of illness or for preventing chronic disease.

Section 3. Low concordance of CAI women's perspectives and provider perspectives (Table 3)

In Section 3 we represent themes with low concordance - low coverage or differing perspectives - between pregnant CAI women and their providers. These represent themes where women either had difficulty grasping certain concepts (e.g., future risk of illness), or providers could have missed a counseling opportunity or not fully picked up on CAI women's motivation for change. They represent opportunities for providers to deliver basic health education messages and then tailor them to emerging concerns discerned through conversations with CAI women.

3.1 Use analogies to describe sugars and diabetes: "The sugar goes to your blood, like a river."

CAI women had little understanding of how diabetes manifests in the body and its physiology beyond "having sugar in the blood." One provider used an analogy: "…you have a blender in your stomach…that grinds everything until it becomes really, really small little particles…and those little pieces all become sugar. And the sugar goes to your blood, like a river…the sugars go inside the muscle, inside the eyes, inside the kidney, inside the legs, so they can give you energy…they need to have in-between amount of sugar to be healthy."

Providers who describe the metabolic processes using simple, clear analogies and provide visuals can adjust for lower health literacy among immigrant women and enhance understanding.

3.2 Advise appropriate weight gain during pregnancy; *"As one has more children, one becomes even fatter."*

Providers concerned about excess weight gain during pregnancy as a contributor to maternal complications such as GDM addressed the link between diet and weight. Providers counseled mothers by advising if they gained too much weight, and referred them to nutritionist and health promotion services to further guide women in healthy gestational weight gain. One woman at 6 months gestation stated that the providers told her she weighed too much and needed to go on a diet for the baby, because "when the baby is too fat…the danger is that blood pressure rises or it can give me diabetes. When one is pregnant you get cravings to eat everything, that's why now I have to eat less."

Providers did not have a set amount of weight that they used as a cutoff for counseling, and clinical judgment typically assessed a combination of factors including existence of comorbidities, prior GDM, pre-pregnancy weight, and a 15-20 pound weight gain early in pregnancy or a rapid rate of weight gain. When providers counsel CAI women, they discussed the risks to the mother and the baby during pregnancy: "…if you gain a lot of weight, your baby gains a lot of weight and …It's not fun to push out a 10 pound baby you know a 10 pound baby isn't healthy." Providers framed excess gestational weight gain as risky for both the mother and baby.

CAI women – both GDM and non-GDM – concerned by such warnings expressed their subsequent changes in dietary intake. As one woman described, "it's helping me a little…the diet they put me on for diabetes…how I should eat less, it helps me not to gain

much." Women feared complications of GDM, cesarean section, or having the baby put on too much weight. CAI women were also highly aware of added weight they had put on over prior years and during past pregnancies, and several expressed concern that they were gaining too much weight during the current pregnancy. One woman lamented "As one has more children, one becomes even fatter. Before I was very thin." Providers that give anticipatory guidance for weight reduction postpartum can readily address women's concerns.

3.3 Convey risk of future diabetes after GDM: *"when the baby is born, maybe the diabetes will be gone"*

Most gestational diabetics distinguished GDM and type 2 diabetes as "two types." Most CAI women had never heard of GDM prior to their diagnosis, and considered it a temporary condition that manifested in pregnancy. Women, however, identified diabetes as a serious and debilitating illness without a cure that frequently leads to amputations and death. Women appeared to feel reassurance that GDM would "go away" or "disappear" when the baby was born, yet did not necessarily link the temporary condition with shared risk factors of diabetes. As one provider explained "…most of them think, this is not forever, this is going to be *just* until I have the baby, this is not going to last. And most of the time it doesn't - but I think that is one key that helps- when they find out that 'uh-oh I'm one of the ones this is going to stay for the rest of my life' *that* sometimes is the bigger challenge."

Some providers acknowledged the challenge of conveying the appropriate balance of risks to GDM women – not to over elevate anxiety, but to responsibly caution them about their risk for diabetes, since "quite a few patients that were GDM that are now diabetics…even as short as 3 years." A couple women stated that they would resume their normal way of eating if the providers told them everything was fine and that their GDM

went away. On the other hand, many GDM women perceived continued risk "Now supposedly I don't have it, but I have to be careful with my diet so that I don't develop diabetes...not gestational diabetes but the normal one." Providers needed to link the "temporary condition" of GDM with shared risk factors for type 2 diabetes and preventing it with a healthy diet.

Providers mainly counseled gestational diabetics about their future risk at the 6 week postpartum diabetes check; if the GDM resolved, providers would reiterate that women remained at higher risk for diabetes and should continue to eat fewer carbohydrates, reduce sugar, balance food groups, and maintain many of the dietary changes followed during pregnancy. A significant proportion of CAI women, however, do not return for the postpartum diabetes test, or do so potentially months later. Beginning counseling earlier during the gestational period may help women to prepare for healthy eating post pregnancy to prevent or delay diabetes.

3.4 Increase temporal salience and susceptibility to chronic disease: *"it could happen now, 'cause I almost had diabetes"*

CAI women were mixed in their perception of their personal susceptibility to chronic illness. Women with a diet-related comorbid condition such as hypertension or anemia – or who have family members with diabetes – tended to perceive higher risk of health complications and were more receptive to making dietary changes. Moreover, many women had a keen awareness of diabetes, having witnessed painful consequences and family members' suffering from "damage to organs, losing vision, problems with kidneys, or losing some part of the body due to circulation problems."

Other women, particularly younger mothers, considered that they had "half their lives to get sick" and did not necessarily consider themselves at risk for chronic illness.

Providers described the challenge of conveying risk, stating that "…it's too abstract…they don't grasp their risk because there's nothing that they can see, touch, or feel." One young mother cited her reason for becoming concerned about her diet: "Mainly it's all her [the baby]. I guess I was really immature before. I'm only 20 so before I wasn't too worried, I'm like "If I'm gonna get sick, I'm gonna get sick when I'm 40 or 50." Now I'm thinking about it and no, it could happen now, 'cause I almost had diabetes." Her testing high on the GDM screening alerted her to near-term risks; when appropriately explaining the risk factors, testing may increase susceptibility to illness.

CAI women primarily cited overweight, eating too much sugar, insufficient exercise, and heredity as contributory causes of diabetes. The perceived inevitability and timing of their susceptibility, however, varied under a balance of factors. Some providers sought to increase women's risk perception for diabetes through providing anecdotes of relatable others, "because they tend to internalize more if they know that there is an actual person that has had these problems." Drawing connections to the experiences of afflicted friends or family, explaining screening tests appropriately, or providing anecdotes of relatable others, could thereby increase women's personal susceptibility to chronic illness.

3.5 Recognize changing self-concept and activate resilience framework to "seguir luchando" - continue fighting: *"I would have to be fighting every day for my life and that of my children's"*

New mothers in particular expressed significance of the transition to becoming a mother, acknowledging profound changes in self-concept. One new mother described "I am most excited because this is my first baby and I am happy…I feel like…I am formalizing myself…becoming more committed to my baby…having a reason for whom to work." Providers largely did not report talking about identity change, though one noted prenatal

classes as a place where it came up and they do "some roleplaying with emotional changes in pregnancy."

When asked about the transition to motherhood, many mothers reflected on the bittersweet emotions that arose from becoming a mother once again. The sadness and the struggles they endured remained at the forefront of their minds as they weighed the sacrifices they made in moving away from their home countries to create a second life in the United States. Many women recounted traumatic border crossings and experienced continued hardship as immigrants juggling low-income work with limited English abilities. While many CAI women also sought to earn enough money to bring the children over to the United States, there was uncertainty around reunification based on legal and economic constraints, and mothers expressed a deep sadness for the separation from their loved ones. Due to the profound transition, becoming a mother again simultaneously elicited mixed emotions of sadness and joy. Yet, most women remained forward looking, "grateful for the gifts that life gives us" for having the opportunity to create a better life for themselves and their families. Becoming a mother again marked a deeply meaningful and emotional transition.

CAI women expressed the desire and determination to *"seguir luchando"* - to continue fighting – that embodies the powerful spirit of resilience directing their goals for the future. As one GDM woman described "It is like a challenge also because I would have to be fighting every day for my life and that of my children's, because one always is thinking to see them grow up...so it would be more difficult and more painful, but with much more responsibility." When mothers aligned preventing chronic illness as fundamental to her goals for establishing a better life, it activated a resilience framework to fight for her family. Providers could encourage CAI women by setting up a frame of better health as part of a

better life given the emotional salience this strengthening perspective holds for many immigrant women.

DISCUSSION:

This is the first study to investigate approaches to counseling for gestational diabetes among Central American immigrants in the United States. The study also identified health communication messages and strategies for the prevention of future diabetes and generated implications for this population.

Overall, health care providers at Mary's Center, a Federally Qualified Health Center in Washington, D.C., had extensive experience working with Central American immigrants and identified culturally sensitive and effective strategies for counseling women on healthy eating and gestational diabetes. The strategies identified through in-depth interviews could be used by other health organizations serving CAI women, and evaluated for transferability to other Latina groups or low-income populations.

We apply a novel framework to contextualize the findings, drawing upon the concept of the teachable moment, which refers to events or transitions in the life course that present a promising opportunity for behavior change.[55] Interviews with CAI women and their providers resoundingly supported pregnancy as a teachable moment for healthy dietary changes during the prenatal period. The findings from postpartum interviews were also highly suggestive of sustained changes. Mothers' perception of their own nutrition as nourishing their baby during the prenatal period increases receptivity and motivation to healthy dietary changes. The transition to motherhood prominently elicited each of the three teachable moment domains by eliciting affective or *emotional responses,* redefining

the *self-concept or social role* for women, and increasing *risk perception* for effects on the mother and the baby (See Appendix, Figure 1).[55]

The overall implications of tailoring counseling strategies informed by pregnancy as a teachable moment, therefore, are: 1) *Prompt affective or emotional responses*: draw on the mother's love for her children and concern over the family's well-being to make healthy lifestyle changes ; 2) *Redefine self-concept and social role*: activate the mother's social role and align health with providing the best chances for her family in light of creating a second life in a new country; and 3) *Increase risk perception*: elicit and frame near-term tangible risks for the mother and her family that also bear long term consequences.

We evaluated the concordance of perspectives expressed by CAI women and their providers and contextualized the emerging strategies around the creation of a teachable moment. We found high concordance of themes when directly related to the mother's or baby's wellness during pregnancy. Effective counseling activated mother's motivation to eat well to nourish the baby - and for some mothers, to manage gestational diabetes (risk perception), love for the baby (emotion), and the mother's perceived role to guard the family's health (social role). In addition, the high concordance themes often reflected near-term motivations for the mother's and baby's health that elucidated observable and immediate risks.

While not as universally expressed, the themes of moderate concordance appear to be promising strategies. Integrating these more extensively within counseling may improve alignment in perspectives, for instance cultivating life course nutrition for the child and illustrating the cost of prevention vs. real cost of illness.

Finally, low concordance themes were areas of less overlap or differing perspectives among CAI women and their providers. Women either had difficulty grasping certain

concepts (e.g., future risk of illness), or providers could have missed a counseling opportunity or not fully picked up on CAI women's motivation for change (e.g. the breadth of the social role and identity transformation that encompasses fighting for the family). To enhance counseling around these areas of lower concordance, providers may need to begin with assessing women's overall concerns and stage of change to understand the context of their lives and how to promote lifestyle changes. Providers may then deliver basic health education messages and tailor these to emerging concerns discerned through conversations with women. For instance, providers may encourage women to describe their near-term goals and plans, inquire about their experiences and challenges in their day-to-day lives, and ask women about the health or condition of family members. Based on the salience of women's concerns for their own well-being or that of their families, providers may identify and frame near-term interests (e.g., increasing energy and functionality to work and care for the family) to convey the importance of health promotion that fits with women's overall life goals.

Overall, low concordance themes may require that providers first engage in broader information-gathering to understand the context of women's lives in order to identify ties to health promotion. Providers may then frame their counseling around near-term salient concerns that would enable women to improve their well-being. For themes of moderate concordance, providers may educate further on the existing concerns that women have identified and progressively enhance their lifestyle modification using motivational interviewing. For high concordance themes, providers have the opportunity to reinforce women's existing motivation with positive reinforcement to facilitate maintenance of changes. For all high, moderate, and low concordance themes, providers enhance counseling by capitalizing on emotional ties women have for engaging in health promotion that hold near-term significance.

Notably, future time perspective contributed in part to areas of low concordance, based on the difficulty for individuals to envision future consequences or outcomes resulting from current behavior – a challenge of chronic disease prevention.[49] Themes of low concordance existed in each of the teachable moment domains, reflecting the challenge of imagining long-term effects that can result from an unhealthy diet or obesity. Provider counseling strategies that alternatively orient women to near-term effects of diet could enhance the effectiveness of health communication. For instance, providers may encourage mothers to develop a perspective that extends the nutritional frame from feeding the baby to cultivating healthy eating patterns for children over their lives. Mothers who perceive the impact of the family diet on healthy growth and development of their children, beginning with complementary feeding through the teenage years, may be better able equipped to make healthy eating changes for the family as a whole.

Emergent themes that increased risk perception included factors that cued women to instill healthy changes in the family. These compellingly had roots in emotionally salient factors (e.g., young child is overweight or has high cholesterol) and also near-term relatable outcomes (e.g., witnessing suffering of family members with diabetes). In addition, strategies that highlighted near-term tangible effects of healthy eating were more relatable to women; many overweight or obese CAI women voiced concerns over their higher weight gain over the years and expressed postpartum weight loss goals. Providers who draw a strong link between healthy eating and exercise to a healthy weight may capitalize on women's motivation at a time of high weight concern. As researchers have posited, pregnancy may be a teachable moment for weight control, and tying this outcome to dietary behaviors as a precursor may simultaneously address both obesity and healthy eating.[34] In addition, mother's alarm over children's overweight status and their resulting motivation to

change the family diet speaks to the promise of family-level interventions for promoting healthy eating for the mother and/or child.[138]

Other near-term orienting factors that motivated women to make dietary changes consisted of existing co-morbid conditions such as high cholesterol or high blood pressure; familiarity with family members suffering from diabetes or other chronic illnesses, and understanding the true costs of long-term illness relative to the cost of prevention. Providers who speak to CAI women's emotional concerns in their counseling tend to bring the future risk of illness closer to tangible near-term consequences. As exemplifies the challenge of behavioral modification for chronic disease prevention, temporal discounting for adverse outcomes occurs when risks are uncertain and farther in the future.[49] Cueing near-term consequences can effect the same desired behaviors.

An important aspect of the teachable moment, therefore, is drawing upon emotion in health communication, since the pregnancy transition prompts strong affective and emotional responses. Providers can use emotional cues to bring up relatable scenarios such as love of the baby and motivation to raise a healthy child, to provide anecdotes of other people who have had repercussions from diet-related illness, and to activate a spirit of hope and encouragement for mothers who have sacrificed so much in recreating a second life in the US. Women developed resilience by persevering through challenges and are inspired to create the healthiest lives possible for themselves and their children.

Research has consistently identified the key theme of *familismo*, or familism, in US Latinos that refers to "feelings of loyalty, reciprocity, and solidarity towards members of the family, as well as the notion of the family as an extension of self."[139] Emerging social and ecological research has supported familism as promoting risk-reducing behaviors that may facilitate better health outcomes.[139] Indeed, familism, the value Latinos place on the family,

has been attributed as the reason for the epidemiological paradox (sometimes termed the "Latino paradox") observed between the minority status of Latinos and their relatively better health outcomes compared to other racial/ethnic groups.[140] The strong motivations and values tied to the family may enable CAI women to envision near term outcomes and formulate reasons to sustain healthy changes for the long-term. The strong relevance of this perspective to health communication merits integration in health care settings to enhance culturally tailored counseling.

Resilience emerged as an important theme that enabled CAI women to "*seguir luchando*," or to continue fighting for a better future. Many women affirmed their dedication to "little by little" improve their lives and that of their families, to which they closely linked protecting health and wellness. Resilience, therefore, may be a mitigating factor between the challenging circumstances for CAI women and their desire for well-being for their families that may prompt enduring commitment to better health. Resilience is defined as "the maintenance of positive adaptation by individuals despite experiences of significant adversity." [141] Research on resilience has been primarily conducted in psychology and psychiatry and examines how individuals engage in a dynamic process of positive adaptation after exposure to significant threat or adversity.[141, 142] Many Central American women built up resilience as a result of the experiences they endured such as traumatic border crossings or escaping violence at home when immigrating to the US. Furthermore, the emotional, social, and economic challenges CAI women confront on a daily basis living as immigrants, many them undocumented, have necessarily added to their resilience.

CAI women experience a profound lack of control over many aspects of their lives as a consequence of their situation. Many low-income Central American immigrants who do not have the security of legal status experience anxiety in day-to-day challenges, and

mothers fear being taken away without notice and having to leave their young children behind. Relative to the low control immigrant women have with respect to social and legal status, they may see improving the family's diet and preventing obesity and diet-related illnesses for the household as one aspect that they have control over. Resilience thereby manifests as courage and determination to confront emerging challenges and to overcome obstacles. As a result, many expectant mothers who learned of their risks for chronic illness from health provider encounters subsequently took on the challenge of persevering through lifestyle changes to decrease her family's risks.

Importantly, counseling may cue the mother's social role to protect the family by helping her draw the connection between preventing chronic illnesses and creating a better life for her family. In the face of these challenges, providers who use strength-based strategies such as motivational interviewing encourage women to recognize their own skills and foster women's resilience and capacity to confront obstacles. The widely used counseling approach recognizes that consistently focusing on strengths increases motivation and enthusiasm, and also changes perceptions of self, family members, and providers.[143] The process of tying healthy lifestyle behaviors to creating the best chances for the family may empower CAI women, as they "fight every day" to establish a second life in the United States. A strength-based counseling approach therefore becomes even more empowering for this population, as women increase their capability and pride for making healthy changes for the family, and identify solutions that work within the context of their lives.

Notably, activating the mother's resilience emerges as a prominent strategy to engage women in making healthy changes, to "continue fighting" through the challenging

process of lifestyle modification, and to sustain health promoting behaviors over their lives while instilling the same mindset in their children.

Strengths

This study has several strengths. It was devised from needs identified by a community clinic and implemented through an academic--community collaboration with stakeholder triangulation. Multiple perspectives were obtained through use of qualitative interviews with providers and CAI women and reviews of clinic charts. Member checking to share and obtain feedback on preliminary findings with key providers and collaborators at Mary's Center enhanced the accuracy and depth of the analysis. In-depth interviews with CAI women generated insightful perspectives to aid with health communication in the clinic setting; in addition, women had an opportunity to express themselves and disclose emotional concerns that they may not often have space to release.

Limitations

We identified several limitations to this study. First, the follow-up interviews conducted at 3-6 months after birth of the baby may not capture a sufficiently long period of time to investigate the sustainability of dietary changes over the long-term. While these interviews were conducted after the postpartum period and allow for a more regular pattern of eating to be established, continued changes and stabilization may still occur during the transitional time. Future studies that can follow up with women a year or year and a half later may better assess the sustainability of their dietary changes. Second, we were able to follow up with only half of the women for a postpartum interview; there may be differences in the experiences of those who we were able to contact and who were willing to participate (e.g., barriers that hinder dietary or behavior change). Third, given the

unique sociopolitical experience of CAI women, the transferability of the findings to other Latino groups and even non-Latina women may be limited.

Implications for practice and further research

Since CAI women are highly motivated to safeguard the health of their families, provider counseling that accounts for the concerns of the whole family accesses multiple points of influence. For instance, pediatricians monitor growth and development of the child, and advise mothers if children are overweight or developing comorbidities. CAI women were highly motivated to improve the family diet upon receiving such cautions. Hence, mothers optimize children's nutrition if they extend the notion of feeding the baby to raising a healthy child over the life course. Providers play a critical role in facilitating this perspective transformation during pregnancy, postpartum, and reinforced at subsequent family visits to establish a life course commitment to health. A team coordinated care approach among pediatricians, adult medicine, health promotion, and prenatal care providers could reinforce counseling and increase shared dialogue to effectively address family health concerns.

Also, given that the majority of CAI pregnant women in the clinic population were overweight or obese and often had additional risk factors, they could benefit from lifestyle counseling during pregnancy to prevent chronic diseases longer term. Since pregnancy is one of the few periods in the life course with high receptivity and frequent accessing of health services - particularly for this low-income and immigrant population - providers should capitalize on the promising opportunity for behavior change.

The transferability of the resilience framework to other pregnant populations may differ, potentially with attenuated effects for behavior change around healthy eating and

GDM. We expect that pregnancy holds great potential as a teachable moment for most pregnant women, although the emotional salience and transformation of maternal identity may vary among groups. For all populations, however, increased positive reinforcement and continuity of care has the potential to mitigate diminishing effects of health promotion counseling as time progresses beyond the teachable moment of pregnancy.

Future studies

Future studies may develop and test the effectiveness of health communication strategies for GDM prevention and management informed by pregnancy as a teachable moment for the CAI population. Furthermore, longitudinal follow up with prior GDM women up to 5 years later would allow for assessment of changes in diet and weight, observation of GDM resolution, as well as recurrence of GDM in future pregnancies and transition to pre-diabetes or diabetes.

Potential interventions may also examine other modalities for delivery, for instance a social media platform as a supportive role for healthy dietary change and diabetes risk-reduction to increase reach and allow for tailoring for low-income minorities.[144] The effectiveness of counseling may also be examined in group-based in-person prenatal care, such as integrated in the Centering Pregnancy group care model.[145, 146] In the Mary's Center clinic, the interactive sessions among peers of pregnant Latina women grouped by expected delivery date appeared to foster social support and empathy, and enabled women to share pragmatic strategies to address common barriers. Group facilitators such as certified nurse-midwife and health promotion counselors may counsel strategically on dietary change, GDM, and preventing diabetes, drawing on factors identified in this study that make pregnancy a teachable moment including fostering resilience for behavior change.

REFERENCES:

1. Ferrara A, Hedderson MM, Quesenberry CP, Selby JV. Prevalence of Gestational Diabetes Mellitus Detected by the National Diabetes Data Group or the Carpenter and Coustan Plasma Glucose Thresholds. Diabetes Care. 2002; **25**(9): 1625-30.

2. Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, Damm P, et al. International association of diabetes and pregnancy study groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. Diabetes Care. 2010; **33**(3): 676-82.

3. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2012; **35 Suppl 1**: S64-71.

4. Bardenheier BH, Imperatore G, Gilboa SM, Geiss LS, Saydah SH, Devlin HM, et al. Trends in Gestational Diabetes Among Hospital Deliveries in 19 U.S. States, 2000-2010. Am J Prev Med. 2015; **49**(1): 12-9.

5. Torres R. Access Barriers to Prenatal Care in Emerging Adult Latinas. Hispanic Health Care International. 2016; **14**(1): 10-6.

6. Coustan DR, editor. Medical Management of Pregnancy Complicated by Diabetes. 5th ed; 2013.

7. Facchinetti F, Dante G, Petrella E, Neri I. Dietary interventions, lifestyle changes, and dietary supplements in preventing gestational diabetes mellitus: a literature review. Obstet Gynecol Surv. 2014; **69**(11): 669-80.

8. Bellamy L, Casas JP, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. Lancet. 2009; **373**(9677): 1773-9.

9. Kim C, Newton KM, Knopp RH. Gestational diabetes and the incidence of type 2 diabetes: a systematic review. Diabetes Care. 2002; **25**(10): 1862-8.

10. England LJ, Dietz PM, Njoroge T, Callaghan WM, Bruce C, Buus RM, et al. Preventing type 2 diabetes: public health implications for women with a history of gestational diabetes mellitus. Am J Obstet Gynecol. 2009; **200**(4): 365 e1-8.

11. Ferrara A, Ehrlich SF. Strategies for diabetes prevention before and after pregnancy in women with GDM. Curr Diabetes Rev. 2011; **7**(2): 75-83.

12. Bennett WL, Robinson KA, Saldanha IJ, Wilson LM, Nicholson WK. High priority research needs for gestational diabetes mellitus. J Womens Health (Larchmt). 2012; **21**(9): 925-32.

13. Hall PA, Fong GT. Temporal self-regulation theory: A model for individual health behavior. Health Psychology Review. 2007; **1**(1): 6-52.

14. Kumanyika SK, Bowen D, Rolls BJ, Van Horn L, Perri MG, Czajkowski SM, et al. Maintenance of dietary behavior change. Health Psychology. 2000; **19**(1, Suppl): 42-56.

15. Flegal KM, Ezzati TM, Harris MI, Haynes SG, Juarez RZ, Knowler WC, et al. Prevalence of diabetes in Mexican Americans, Cubans, and Puerto Ricans from the Hispanic Health and Nutrition Examination Survey, 1982-1984. Diabetes Care. 1991; **14**(7): 628-38.

16. Hawkins M, Hosker M, Marcus BH, Rosal MC, Braun B, Stanek EJ, 3rd, et al. A pregnancy lifestyle intervention to prevent gestational diabetes risk factors in overweight Hispanic women: a feasibility randomized controlled trial. Diabet Med. 2015; **32**(1): 108-15.

17. McBride CM, Emmons KM, Lipkus IM. Understanding the potential of teachable moments: the case of smoking cessation. Health Educ Res. 2003; **18**(2): 156-70.

18. Coa KI, Smith KC, Klassen AC, Caulfield LE, Helzlsouer K, Peairs K, et al. Capitalizing on the "teachable moment" to promote healthy dietary changes among cancer survivors: the perspectives of health care providers. Support Care Cancer. 2015; **23**(3): 679-86.

19. Phelan S. Pregnancy: a "teachable moment" for weight control and obesity prevention. Am J Obstet Gynecol. 2010; **202**(2): 135 e1-8.

20. Monte S, Valenti O, Giorgio E, Renda E, Hyseni E, Faraci M, et al. Maternal weight gain during pregnancy and neonatal birth weight: a review of the literature. J Prenat Med. 2011; **5**(2): 27-30.

21. Lawson PJ, Flocke SA. Teachable moments for health behavior change: a concept analysis. Patient Educ Couns. 2009; **76**(1): 25-30.

22. Elder JP, Ayala GX, Parra-Medina D, Talavera GA. Health communication in the Latino community: issues and approaches. Annu Rev Public Health. 2009; **30**: 227-51.

23. Zong J, and J. Batalova. Central American Immigrants in the United States. 2015 [cited 2016 Feb 22]; :[Available from: http://www.migrationpolicy.org/article/central-american-immigrants-united-states

24. Pabon-Nau LP, Cohen A, Meigs JB, Grant RW. Hypertension and diabetes prevalence among U.S. Hispanics by country of origin: the National Health Interview Survey 2000-2005. J Gen Intern Med. 2010; **25**(8): 847-52.

25. Torres JM, Wallace SP. Migration circumstances, psychological distress, and self-rated physical health for Latino immigrants in the United States. American journal of public health. 2013; **103**(9): 1619-27.

26. Ritchie J, Spencer, L. Qualitative data analysis for applied policy research. In: Bryman A, Burgess, R., editor. Analysing qualitative data. London: Routledge; 1993. p. 173–94.

27. Ayala GX, Ibarra L, Arredondo E, Horton L, Hernandez E, Parada H, et al. Promoting healthy eating by strengthening family relations: design and implementation of the Entre Familia: Reflejos de Salud intervention. Cancer disparities: Causes and evidence-based solutions. 2011: 237-52.

28. Katiria Perez G, Cruess D. The impact of familism on physical and mental health among Hispanics in the United States. Health Psychology Review. 2014; **8**(1): 95-127.

29. Roszler JaWSR. Approaches to Behavior: Changing the dynamic between patients and professionals in diabetes care and education. Alexandria: American Diabetes Association; 2015.

30. Luthar SS, Cicchetti D, Becker B. The construct of resilience: A critical evaluation and guidelines for future work. Child Development. 2000; **71**(3): 543-62.

31. Rutter M. Psychosocial resilience and protective mechanisms. American Journal of Orthopsychiatry. 1987; **57**(3): 316-31.

32. Harvey JR, Ogden DE. Obesity treatment in disadvantaged population groups: where do we stand and what can we do? Prev Med. 2014; **68**: 71-5.

33. Trudnak TE, Arboleda E, Kirby RS, Perrin K. Outcomes of Latina women in CenteringPregnancy group prenatal care compared with individual prenatal care. J Midwifery Womens Health. 2013; **58**(4): 396-403.

34. Mary's Center. The Centering Pregnancy Model of Care. 2016 [cited 2016 Mar 27]; Available from: http://www.maryscenter.org/article/centering-pregnancy-model-care

APPENDIX

Figure 1: Conceptual Model for Pregnancy as a Teachable Moment for Dietary Change and Diabetes Prevention

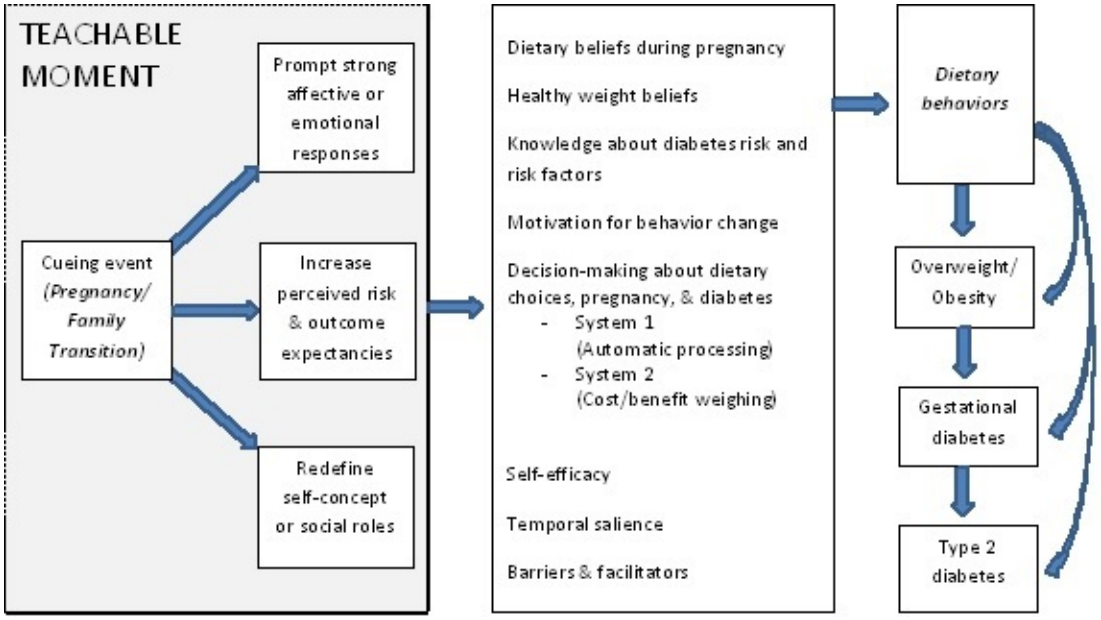


Table 1: High concordance

between pregnant CAI women and health care provider perspectives

Themes of high coverage and similar perspectives among pregnant CAI women and their providers

Themes	Selected quotes	Health communication implications
1.1 Capitalize on pregnancy transition to motivate mothers	"They are more receptive to change because they are changing already." (Provider) "I started to take them [changes] more seriously since I am pregnant again because I want everything to go well for me…if I am well my baby will be too. If I don't take of myself there is a risk that I can pass something to my baby." (CAI)	Engage mothers in healthy lifestyle changes given their high receptivity and motivation during pregnancy for the baby's health.
1.2 Emphasize influence of maternal nutrition on the baby's health	"…if you tell them it's gonna be good for the baby, they will say ok, I'm going for it." (Provider) "I imagine that what I am eating, my baby is receiving it. If I eat bad foods, he will receive bad foods. That's why I am trying this approach for him too…[he] obtains the same foods that I am eating." (CAI)	Reinforce link between maternal nutrition and baby's health with key recommended changes. Caution GDM complications if blood sugar uncontrolled: women feared - Delivering a large baby - Baby predisposed to diabetes - Cesarean section and surgery
1.3 Activate social role to safeguard family health	"It's [motivation is] for a healthy life, they want to be there for their kids. They want to be healthy, they don't want to suffer in life, they want to be there for their kids, once their kids grow up." [Provider] "…because I don't want to be sick, and I don't want to have anything - I don't want to die! Because I want to see my girls grow up and so…I want to be very healthy for them." (CAI)	Cue motivation to remain healthy for their children and to see them grow up, to heighten the importance of following the treatment plan. Extend recommendations around healthy eating to cooking for the family's health. Highlight importance of self-care to be well for children and to see them grow up.
1.4 Apply a strength-based approach with motivational interviewing	"…highlighting small changes…"Wow, tell me how you did that?! And really building off of the skills that *they* have in helping to…help *them* to	Apply a strength-based counseling approach using motivational interviewing. Enhance sustainability of changes

	recognize the skills that they have and times when they *have* had successes. And it's very basic motivational interviewing." (Provider) "Now I am used to it. I don't drink soda. I thought that I wouldn't be able to do it, … Before I became pregnant with her I was super fat and I didn't want to be that way this time." (CAI)	with positive reinforcement. Convey that they are the experts and empower them to generate their own solutions.

Table 2: Moderate concordance

between pregnant CAI women and health care provider perspectives

Themes of moderate coverage or variable perspectives among pregnant CAI women and their providers

Themes	Selected quotes	Health communication implications
2.1 Make progressive changes over multiple pregnancies	"So you can continue to work on this through multiple pregnancies…I've had some I've been talking about diet for the last 3 babies…some have actually followed their diet better, and lost some weight." (Provider) "I couldn't [stop drinking soda] when I had my son but now with my daughter coming I have to do it." (CAI)	Capitalize on each pregnancy as a subsequent teachable moment for behavior change. Enhance continuity of care to help women make or recommit to lifestyle changes using accountability and positive reinforcement. Work with women to achieve progressive changes over multiple pregnancies.
2.2 Foster women's resolve to prevent or delay diabetes	"[I tell them] following the diet may not totally eliminate that [future diabetes] from ever happening, but if anything it will probably at least postpone it a bit." (Provider) "…you can, not sure if it's 100%, but you can prevent it; you can prevent diabetes when you eat healthy." (CAI)	Affirm that eating healthy can prevent or delay diabetes. Talk about heredity as one factor in risk of diabetes, but is not a determinant. Activate CAI women's resilience framework to prevent diabetes.
2.3 Link healthy eating and physical activity to a healthy weight	"What do other people do to lose weight after they have their baby?" instead of me just saying "well, you should exercise for thirty minutes every day." (Provider) "I would like to exercise because I want to maintain a normal weight and it is better for my health. I believe that exercise and health are combined. In order to have good health, one needs to exercise and eat healthy." (CAI)	Draw explicit connection between healthy eating for a healthy weight. Promote consistent and increased physical activity as essential to health, diabetes, and weight management. Highlight different ways to increase daily activity (e.g., dance, take walks with children).
2.4 Involve family members in lifestyle changes	"…this was a real difficult change for her…she didn't eat any fruits or vegetables. Her typical breakfast was a few cups of coffee and some sweet pastries with her mother. So this was their bonding time." (Provider) "…the two of us we are the same…we are overweight. That's why I want to	Speak to women about context of household food to better understand social experience of eating. Intervene with family members to make healthy lifestyle changes (e.g., bring in partner or mother-in-law to clinic visit, encourage mother to take walks with partner or children

	lose weight and for her [daughter] to lose weight and it's good for me to walk." (CAI)	together).
2.5 Cultivate life course nutrition for the child	"Nutrition is one of those really important jobs that we have as parents…we're thinking about keeping our kids safe…but nutrition is also one of the really important things we can teach our kids how to eat well, we can teach them dishes that are special to our family, and our culture, and focusing on that as well is important." (Provider) "The children must record in their minds that they have to eat healthy for the future and for themselves." (CAI)	Encourage mothers to reframe perspective from feeding the baby to feeding the child over the life course. Activate maternal role to teach healthy eating to children to retain cultural foods and traditions. Emphasize intergenerational transmission of healthy eating and cultural foods, since what children are taught they can pass on to grandkids over generations.
2.6 Illustrate cost of prevention vs. real cost of illness	"… it's not easy to look into the long term future…"What are the complications?" and then "Imagine, yes this does feel like an added cost, but the reality is it's probably 10 or 15 dollars, and what does it cost to be sick? And you can't watch your *grandchildren* because you're not able to get up, or you're in the hospital." (Provider) "…for one's health and thinking about two kids…If I don't take care of my cholesterol it can fill my arteries, my heart can stop and I will no longer even reach fifty years old." (CAI)	Talk with women about near-term and long-term costs to imagine tangible consequences. Frame emotional costs including loss of time with family as a possible consequence.

Table 3: Low concordance

between pregnant CAI women and health care provider perspectives

Themes of low coverage or differential perspectives among pregnant CAI women and their providers

Themes	Selected quotes	Health communication implications
3.1 Use analogies to describe sugars and diabetes	"I've gone to the point of actually drawing…this is your mouth, this is how your food goes in, you have a blender in your stomach…that grinds everything until it becomes really, really small little particles, *really* small little pieces, and those little pieces all become sugar. And the sugar goes to your blood, like a river…And in the blood, the sugars go inside the muscle, inside the eyes, inside the kidney, inside the legs, so they can give you energy… we all need energy and sugar to survive… they need to have *in-between* amount of sugar to be healthy." (Provider) "I heard that your sugar rises a lot, and you can faint, or if it lowers a lot also." (CAI)	Use analogies to describe how diabetes affects the body and metabolizes sugar. Clarify that a balanced level of sugar in the blood gives energy.
3.2 Advise appropriate weight gain during pregnancy	"Sometimes what I say is…if you gain a lot of weight, your baby gains a lot of weight and … "It's not fun to push out a 10 pound baby you know a 10 pound baby isn't healthy." (Provider) "As one has more children, one becomes even fatter. Before I was very thin." (CAI)	Describe appropriate amount of weight gain and caution mothers of the risks of excess weight gain on mother and baby. Provide anticipatory guidance for weight reduction postpartum, to address women's concerns to lose weight accumulated over the years and from pregnancy.
3.3 Convey risk of future diabetes after GDM	"…most of them think, this is not forever, this is going to be *just* until I have the baby, this is not going to last. And most of the time it doesn't - but I think that is one key that helps- when they find out that 'uh-oh I'm one of the ones this is going to stay for the rest of my life' *that* sometimes is the bigger challenge." (Provider)	Convey continued risk of GDM recurrence and future diabetes if not modifying diet or weight. Link the "temporary condition" of GDM with shared risk factors for type 2 diabetes and preventing it with a healthy diet. State near term risk of developing

	"be careful with my diet so that I don't develop diabetes...not gestational diabetes but the normal one." (CAI)	diabetes in as short as 3-5 years after GDM; emphasize need for continued prevention.
3.4 Increase temporal salience and susceptibility to chronic disease	"…nothing concrete that they can see. Risk is a word that I mean not everybody has a good grasp on. Like for them it's too abstract." (Provider) "Mainly it's all her [the baby]. I guess I was really immature before. I'm only 20 so before I wasn't too worried, I'm like "If I'm gonna get sick, I'm gonna get sick when I'm 40 or 50." Now I'm thinking about it and no, it could happen now, 'cause I almost had diabetes." (CAI)	Give anecdotes of relatable others to help women imagine others with that condition to perceive greater susceptibility. Identify family members with diabetes to increase emotional salience and underscore increased risk due to heredity. Counsel women experiencing any diet-related comorbidity – e.g., hypertension, high cholesterol, or elevated glucose – or women with afflicted family members – to draw on awareness of complications. Appropriately explain GDM screening test to convey existence of near-term risk and its risk factors.
3.5 Recognize changing self-concept and activate resilience framework to *"seguir luchando*" – continue fighting	"it's [identity change] something that comes up in the prenatal classes and we talk about and do like some roleplaying with emotional changes in pregnancy….our identity *does* change when we have babies…"(Provider) "It is like a challenge also because I would have to be fighting every day for my life and that of my children's, because one always is thinking to see them grow up." (CAI)	Discuss and roleplay identity change in prenatal counseling. Activate CAI women's resilience framework to protect the family by fighting to create the best chances for children.

J. CONCLUSIONS

This is the first study to investigate pregnancy as a teachable moment for dietary change and diabetes prevention among low-income Central American immigrant (CAI) pregnant women in the Washington D.C. metro area. The perspectives of CAI women and their health care providers demonstrated strong support for this novel approach to behavior change. This dissertation used qualitative and quantitative methods to investigate dietary changes and gestational weight gain during pregnancy. In-depth interviews with CAI women and health care providers generated insight on optimal counseling for healthy eating as it relates to GDM as well as implications for later diabetes. We found that expectant mothers exhibited high receptivity and motivation during pregnancy to make healthy changes for self and baby, marking pregnancy as a unique and opportune time for delivering health promotion counseling.

This dissertation significantly furthers the research on teachable moments for healthy eating over the life course and explicates principles that may guide future research on this concept. Given the rise of diet-related chronic disease and the challenge of sustaining healthy dietary change, this strategy bears public health significance to reduce the burden of obesity and diabetes. Furthermore, we conducted in-depth investigation using a mixed-methods approach to identify health communication messages and strategies for CAI women to enhance culturally competent care. Given the greater burden of obesity and diabetes among low-income Latinas in the United States, effective strategies are needed to aid underserved populations at higher risk of chronic illness. Teachable moments during pregnancy for such populations have the added potential to reduce health disparities by reducing lifetime risks of illness for both the mother and baby.

This dissertation also bears theoretical implications on the initiation and maintenance of health behavior change. Behavioral scientists have not yet identified

sustainable means to encourage maintenance of healthy lifestyle change; financial incentives have engendered much testing yet are problematic in their potential for sustainability.[147] Drawing upon the dual processing system of decision making underscores the role of emotion and autonomic processes in behavior change that may better facilitate chronic disease prevention.[69] The recommendations for health communication identified in this dissertation are informed by the understanding of such affective and emotional drivers in decision-making, as well as risk perceptions, barriers and facilitators to behavior change, and changes in social role for expectant mothers. These highly salient factors during pregnancy interact together to generate a potent time for capitalizing on healthy lifestyle modification. Further research that can test the psychosocial processes underlying behavior change can better elucidate the role of these elements in sustainable behavior change.

Notably, postpartum interviews revealed positive implications for the continuation of healthy eating over the long-term when mothers undergo a process of transformative learning. Since effective teaching is dependent on dynamics of learning, Mezirow's adult learning theory elucidates how engaging in critical reflection around a teachable moment allows for perspective transformation. When applied to life course dietary change, mothers who undergo perspective transformation necessarily extend their near-term motivation to eat well for perceived direct impacts on herself and the baby to fostering a healthy household over the long-term through the family diet. The redefined self-concept and social role mark a critical aspect of learning and allow for continued behavior change beyond the relatively short pregnancy period. Future studies should explore long-term sustainability of healthy dietary change after implementation of health communication strategies informed by teachable moments. Following up with participants ideally over several years would elucidate the processes of learning for sustainable behavior change and allow for more conclusive implications to be drawn.

This dissertation study and other studies found that mother's increased awareness of nutrition during pregnancy supports it as a pivotal time for life course behavior change.[127] In Aim 1 we identified three key teachable moments over the pregnancy period: to provide nutrition education at transitions in eating behavior coinciding with physiological changes in pregnancy (TM1); to counsel on risks of GDM timed around testing and diagnosis (TM2); and to communicate long-term diabetes risk when reengaging mothers in care postpartum (TM3). Each of these teachable moments present compelling opportunities for healthy dietary change that capitalizes on the mother's motivation to promote nutrition during pregnancy, prevent excess weight gain and lose weight postpartum, and reduce risks of diabetes through healthy eating and a healthy weight.

Overall, providers played an integral role in the creation of teachable moments given the greater engagement in care during the gestational period for this population of Latina immigrants. The entry to prenatal care doubles as a foot in the door for women's health, and may function in the role of primary care particularly for low-income or immigrant women who often face barriers to care. Health promotion interventions during and between pregnancies may help women engage in lifestyle modification, establish a healthy pre-pregnancy weight, and guide appropriate gestational weight gain. Since concern over weight emerged as a prominent theme for many pregnant women, regardless of presence of GDM or comorbidities, provider guidance and monitoring postpartum for weight loss could substantially aid CAI women, most of whom were overweight and sought guidance for healthy lifestyle modification.

Approaches to health promotion for low-income or immigrant populations must account for the socioeconomic factors that underlie a critical aspect of health care access, delivery, and engagement. We found that providers remained cognizant of the complex challenges that low-income immigrants face, and referred women seeking prenatal care to

wraparound services within the FQHC (e.g., social services, mental health) to address their principal challenges. Mary's Center embraces a powerful Social Change Model that takes a holistic, multipronged approach to care for their participants "to put them on the path toward good health, stable families, and economic independence."[148] ENREF 147 The Center effectively delivers integrated health care, education, and social services to individuals and families inclusive of child, teen, and adult participants. While not all community health centers may offer this extent of wraparound services, facilitating referrals to accessible resources within the community will enable individuals and families to build up strong social and economic foundations critical to health and wellness. CAI women accessing care in this supportive setting have a greater opportunity to bring about sustainable changes in their lives and to progressively overcome barriers.

Overall, I present the following synopsis of key health communication strategies generated from this study to inform both care providers and researchers. These recommendations may assist community organizations or health care providers - inclusive of those in clinical care, health promotion, and social services - working with CAI women to capitalize on pregnancy as a teachable moment for healthy dietary change and diabetes prevention. Researchers may also refine and translate these strategies for application to a specific setting or population. I highlight specific points of focus under each recommendation.

1. **Foster realistic, progressive changes for dietary modification**
    - Provide options and identify healthy and tasty foods women like to eat, not just "don'ts"
    - Address hunger as challenge in diabetic diet (e.g., increase fiber, balance with protein)

- Reduce carbohydrates “you used to eat 7 tortillas, so let’s try to get to 3…”
- Foster cooking skills and strategies for healthier preparations and encourage eating less processed food
- Making small changes rather than stopping, to avoid deprivation

2. **Integrate consistent positive reinforcement in counseling**
    - Use motivational interviewing to assist women in developing strength-based strategies
    - Empower women in their capacity to take control over an aspect of their lives– feeding the family is something they can do and to teach children healthy eating
    - Provide positive reinforcement through continuity of care that draws on accountability, empathy, and ongoing support from providers to sustain healthy lifestyle change
3. **Activate women’s resilience framework to improve the health of the family**
    - Link better health to a better life in promoting the health and livelihood of the family
    - Encourage women to “seguir luchando” - continue fighting to support a healthy household diet to prevent illnesses
    - Develop strategies with women to overcome their time and resource constraints
4. **Integrate dietary counseling early in pregnancy to promote nutrition for majority of women**
    - Capitalize on a period of high motivation during pregnancy to engage women in healthy dietary change

- Reiterate to women that healthy eating and regular physical activity can help to prevent development of GDM and future T2DM
- Support women's engagement in behavior change; building and practicing these skills during pregnancy can help women continue them over the life course

5. **Capitalize on pregnancy as a teachable moment**
    - Capitalize on high receptivity to healthy lifestyle change for the mother's and baby's health
    - Optimize counseling on dietary change and diabetes around transitional points during pregnancy (e.g., try healthy foods after morning sickness, discuss diabetes risks around GDM testing)
6. **Reengage women postpartum in promoting life course family health**
    - Foster women's redefining social role as "epicenter of the family" to guard and promote the health of family over the life course
    - Reiterate continued risk of diabetes at the postpartum diabetes check and specific strategies for how women can prevent or delay it
    - Reinforce women's motivation and strategies to continue long-term healthy changes
7. **Address women's weight concerns and motivation to achieve a healthy weight**
    - Provide weight counseling during pregnancy, particularly to overweight and obese women, to prevent excessive gestational weight gain
    - Provide anticipatory guidance for postpartum weight reduction
8. **Reinforce women's view of family diet as integral to the child's growth and development**

- Extend the perspective of feeding the baby during pregnancy to providing good nutrition for the child's growth and development into child and teen years
- Understand pivotal role of children as mother's priority – pediatricians who monitor and identify overweight children act as bridge to family healthcare

9. **Proactively assist low-income immigrant women in accessing community resources**
    - Recognize complex barriers that women face and connect them with the social, legal, and educational resources integral to achieving health and wellness
    - Proactively engage women around prenatal care, during which they increase health service seeking, to improve reach of an underserved population
10. **Engage women in preventing chronic disease by reframing women's understanding of risk**
    - Diminish "young invincibles" mentality by discussing women's risk for obesity or chronic illness, particularly anchored by testing (e.g. GDM)
    - Use anecdotes to help women understand the risks and draw out women's experiences of friends or family members that have experienced illnesses, noting family history
    - Anchor motivations for healthy lifestyle behaviors to near-term tangible consequences (e.g., more energy, staying well for children)

We hope that the above recommendations will improve maternal health care for CAI women at an influential time in the life course that simultaneously promotes family health.

Given the rising global burden of diet and obesity-related chronic disease, and higher prevalence in Latinas, strategic lifestyle interventions are needed to reduce health disparities. Capitalizing on preventive weight counseling during pregnancy, and following up over the life course, may lead to high population health impact to prevent GDM, lower the risk of lifetime diabetes, and reduce cardiometabolic risks for future generations. The implication of pregnancy as a teachable moment presented in this dissertation poses a promising framework for health communication for chronic disease prevention.

K. LIMITATIONS

The dissertation research has potential limitations.

1) The study was unable to assess the food environment at the community level (e.g., access to supermarkets, farmer's markets, fresh food) which could provide a more comprehensive picture of the environmental barriers or facilitators that shape dietary patterns. In the interviews with CAI women, I inquired about their access to food in terms of cost and convenience, and explored their perceptions of federal nutrition programs. In interviews with providers, I obtained additional perspectives on the environmental influences on their participants' dietary patterns.

2) The study did not have sufficient resources to conduct structured dietary recalls or have other objective means of measuring diet, which may limit assessment of changes to CAI women's dietary behaviors. I qualitatively assessed diet and dietary changes within the interviews and in chart reviews. In the charts, providers in prenatal care and nutritionists typically recorded counseling on diet, particularly for GDM women from an assessment of diabetic food logs. I used these data sources to triangulate the dietary behaviors reported in CAI interviews and chart reviews to identify key dietary patterns relevant to counseling.

3) The cross-sectional and retrospective nature of the quantitative data limited the information obtainable in an alternative study design such as data collected longitudinally. Prospective data would allow for identification of times that bear greatest salience for the teachable moment during pregnancy and postpartum. Prospective quantitative and qualitative follow-up post-partum over several years would provide valuable insight into the continuity of dietary behaviors, the progression of the teachable moment, and development of prediabetes or T2DM for some women.

4) The completeness and accuracy of the quantitative secondary dataset had some limitations, as may occur with research using electronic clinical records. There was inconsistent coding of GDM diagnosis by providers as well as missing data which limited the power and analytical potential of the data. Similarly, in the review of clinic charts, inconsistent provider recording limited the ability to ascertain dietary counseling.

5) The potential for social desirability could affect interviews with CAI women and their providers. CAI women may be hesitant to fully disclose their dietary behaviors or share their perceptions around risk or diabetes, to interviewers or to providers alike. Recall bias may also be present as a result of the self-reporting of diet or dietary changes.

L. STRENGTHS

The proposed dissertation research study has important strengths.

1) Investigating pregnancy as a teachable moment and behavior change for chronic disease prevention added insight to novel health communication strategies to address the challenge of sustainable behavior change over the life course, and bears theoretical significance to the general population.

2) The focus on healthy dietary change around pregnancy and GDM addresses priorities in diabetes prevention research. The study also added to the clinical understanding of weight gain during pregnancy and its association with GDM for Latina women.

3) The research has the potential to reduce health disparities for the growing Central American population in the region facing high risk for obesity and GDM.

4) The research addresses the need for culturally tailored interventions for understudied Latino subgroups. The health communication strategies informed by the study are tailored to cultural values and specific dietary patterns for Central Americans immigrants and may contribute to more effective counseling with a large yet understudied population. Identifying effective health promotion strategies may reduce health disparities for this low-income minority population.

5) The mixed methods research design allowed for quantitative examination of predictors of GDM in a large study population of Central Americans as well as rich qualitative inquiry into psychosocial and contextual influences for prevention behaviors and insights into decision-making. The integration of these methods provided means to investigate pregnancy as a teachable moment for health behavior change.

6) The integration of multiple methods (qualitative interviews and chart reviews) and multiple perspectives (patients and providers) in this dissertation provided a more comprehensive way to explore the teachable moment opportunity.

7) The academic--community collaboration allowed for conducting research in a real-world setting to better inform health communication strategies. Moreover, the partnerships drew upon the respective strengths of each organization to address gaps in research and clinical care.

M: REFERENCES

M.1: Appendix

M.1.1. Codebook for interviews with Central American immigrant women and health care providers

	CODE	DESCRIPTION
A0	Analytical notation	
A1	Theory	Indications of theoretical contribution
A2	Programmatic	Strategies to promote for programmatic relevance
A3	Health comm strategy	Communication strategies for this population
A4	Reflexivity	Examining self as researcher and the research relationship
A5	Key quotes	Illustrative quotes to highlight
B0	Demographic factors (for indexing)	
B1	Country origin	Country of origin (e.g., El Salvador)
B2	Years in US	Number of years living in the US as one proxy for acculturation
B3	Age	Age of respondent
B4	Primi	Primiparous (1st child)
B5	Multi	Multiparous (second or more child)
B6	Risk factors	Stated personal health risk factors related to pregnancy (e.g., prior GDM, age, weight)
B7	Family history	Family members having diabetes or diet-related illness
B8	GDM	Diagnosed with GDM during current pregnancy
B9	Non-GDM	Not diagnosed with GDM during current pregnancy
B10	Postp intv	Postpartum interview conducted
C0	Pregnancy characteristics	
C1	Maternal condition	Perception of maternal condition during pregnancy (e.g., discomfort, fatigue, morning sickness)
C1.1	- Weight	References to weight or weight gain during pregnancy
C2	Baby condition	Observation or assessment of baby (e.g., size, movement, complications)
C3	Preg lifestyle	Changes during pregnancy (e.g., exercise, routines, work, sleep)
C4	Preg expectations	Expressions about expectations for current pregnancy (esp in comparison to prior ones) (e.g., delivery, complications, GDM)
C5	Heredity	Perception of baby being born with characteristics (e.g., heredity), or transmission of characteristics to baby (e.g., passage of GDM, hunger of baby, liking of specific foods)

C6	Delivery	Comments on expected delivery of baby (e.g., clinic factors)
D0	Individual level dietary influences	
D1	Physiological	Biological drive or physiological influence on eating
D1.1	- Hunger	Feeling of hunger, or eating but not feeling full, e.g. satiety
D1.2	- Nausea	Nausea, vomiting, or discomfort related to eating (often "morning sickness")
D1.3	- Cravings	Pregnancy attributed cravings for a certain food
D2	Appetite	Interest in eating a certain food
D3	Taste	Perceived palatability, taste, and sensory quality of foods
D4	Habit	Becoming accustomed to altered patterns of eating
D5	Self-efficacy	Confidence in ability to eat a healthy diet
D6	Motivation	The desire or willingness to eat healthy; stimulus, drive, motive
E0	Household/interpersonal influences	
E1	Social support	Social support from partners, family, friends, or acquaintances (e.g., encouraging mother to eat healthier, emotional support, help around house)
E2	Social strain	Barriers or challenges from partners, family, friends, or acquaintances (e.g., eating foods mother cannot, unsupportive mother-in-law)
E3	Household context	Context of household meal patterns (e.g., meal schedule, social eating context, cooking space)
E4	Food provision	Roles and responsibilities for food preparation or acquisition (e.g., cooking, purchasing groceries)
E5	Family diet	Observation of family dietary patterns, perception of dietary needs, and/or efforts to change diet of family members (e.g., children overweight, want whole family to eat healthier)
E6	Cultural diet	Identification or assessment of foods common to cultural diet (e.g., "we Salvadorans eat")
F0	Environmental dietary influences	
F1	Food access	Factors influencing food purchasing, the ability to obtain foods, or selection of stores (e.g. convenience, cost, proximity of stores, affordability)
F2	Quality of food	Factors influencing shopping for foods and decisions around which to buy (e.g., quality, appearance, freshness, healthfulness)
F3	Prepared foods	Mentions of prepared food purchasing or eating outside the home (e.g., Wendy's, Chipotle, junk food, street food)
F4	Food assistance	Provision of federal nutrition benefits (e.g., typical WIC foods, preferences)

G0	Understanding of diet	
G1	Prescriptive foods	Perception of foods good to eat during pregnancy or as GDM compliant diet
G2	Proscriptive foods	Perception of foods to avoid during pregnancy or as GDM compliant diet
G3	Diet recommendations	Dietary recommendations conveyed by any source
G3.1	- Meal pattern	Changes in meal pattern (e.g., smaller meals 3 times a day)
G3.2	- Portion size	Reduction of portion size (e.g., half of a banana)
G3.3	- Reduce carb	Selecting fewer carbohydrates (e.g. eat fewer tortillas, if eating tortillas don't eat rice)
G3.4	- Balanced plate	Balancing different food groups (e.g., protein with carb)
G3.5	- Preparation method	Cooking food differently (e.g., boil rather than fry, use olive oil)
G4	Diet misconceptions	Confusion regarding dietary discoveries and misconceptions (e.g., fruits have sugar, eating for two)
G5	Diet self-evaluation	Self-evaluation of eating behaviors with acknowledgement or judgment (e.g. admits to poor diet, recognizes "mistakes")
G6	Link diet to diabetes	Perceived relation between diet and diabetes
G7	Link diet to health	Perceived relation between diet and health (exception of diabetes)
H0	Dietary behavior	
H1	Preg diet changes	Changes in eating during pregnancy or due to development of GDM (e.g., specific foods, meal patterning, or quantity)
H2	Prior diet	Dietary behavior prior to current pregnancy, such as 5 or 10 years ago (e.g., prior pregnancy, eating in home country)
H3	Dietary recall	Recall of foods eaten (e.g., prior day, weekend diet, typical meals)
I0	Post pregnancy	
I1	Diet after pregnancy	Future diet plan or expectations (e.g., go back to eating normally, continue with changes)
I2	Postpartum practices	Attitudes or behavioral intention around postpartum diet (e.g., 40-day diet "cuarentena", cultural diet or customs)
I3	Postpartum weight	Expressed desire to lose weight
I4	Breastfeeding	Discussions of breastfeeding plans and practices (e.g., formula, breast milk)
I5	Exercise	Intention or plan for exercise or physical activity after delivery of baby
I6	Postpartum lifestyle	Intention or plan for personal or household changes (e.g.

		involving husband in childcare, social support, returning to work, learning English, crisis plan, stress management)
I7	Family planning	Attitude or intention around current or future pregnancies (e.g., unplanned, wishes for more babies, family planning methods, gifts of God)
I8	Future goals	Comments on future plans (e.g., personal or family) after baby is born
J0	Understanding of diabetes	
J1	GDM management	Aspects of symptoms and management (e.g., medication, pills, insulin, checking blood sugars, diet controlled, physiological response dizziness)
J2	GDM understanding	Knowledge or perception of GDM (e.g., GDM testing and diagnosis, causes, outcomes)
J3	t2DM understanding	Knowledge or perception of t2DM (e.g., management, causes, outcomes)
J4	Future diabetes risk	Knowledge or perception of distinction between GDM and t2DM, risk of GDM not resolving after delivery, perceived risk of developing t2DM in the future
J5	Diabetes narrative	Narratives or identification of family members' or acquaintances' experiences with diabetes
K0	Pregnancy as a teachable moment	
K1	Mat risk perception	Perceived risk of negative maternal health consequences (e.g., risk of diabetes, excess weight gain, cesarean section)
K2	Baby risk perception	Perceived risk of negative fetal health consequences (e.g., risks to baby, fetal development)
K3	Death	Mentions of death for either herself or baby, related or unrelated to pregnancy; awareness of mortality
K4	Emotion	Mentions or expression of emotion or affect (e.g., doubt, fear, remorse, such as fear for baby's health, fear of developing diabetes, excitement or worry for new baby, fear of mortality)
K5	Self-concept	Self –concept and social role (e.g., consciousness of maternal role, being a good mother, new responsibilities, avoidance of stigma, capacity to raise healthy children)
K6	Cueing event	Internal or external event (i.e. trigger) that changes awareness, sets off a response and behavior (e.g., acute illness, GDM diagnosis, accumulated understanding – tipping point of repetition, comorbidities, provider recommendation)
K7	Pregnancy period	Discussion of the pregnancy time period as a favorable or unfavorable period for diet or diabetes prevention (e.g., considerations of prenatal care, timing of interventions, access to care)

L0	Life history	
L1	Life transitions	Perception of personal life transitions or notable experiences (e.g., Mentions of pregnancy as transition, moves, nostalgia or memories, life in home country, proximity of family, ability to work, difficulties of immigrant status)
L2	Immigration challenges	Narrative or comments on the journey of immigration into the United States (e.g., border crossing)
M0	Source of health information	
M1	Info seeking	Pt seeking health information (e.g. regularly seeking tv, internet, facebook, asking provider)
M2	Incidental exposure	Incidental exposure (e.g. coming across educational tv show)
M3	Interpersonal communication	Anecdotal stories or advice from social network (e.g., friends, family members, or acquaintances sharing experience or giving advice)
M4	Provider comm	Demonstration of provider in clinic delivering health education or giving recommendations (e.g, types of providers, strategies of communication)
M4.1	- Nutritionist	Mentions of nutritionist at clinic
N0	Utilization of health services	
N1	Clinic provision	Clinic provision (supply) of health services (e.g. offering programs, scheduling visits, providing referrals)
N2	Patient utilization	Patient utilization (demand) of health services (e.g. coming to visits, accessibility, use of referrals)
N2.1	- Receptive to advice	Positive or favorable attitude, orientation of openness toward recommendations or advice
N2.2	- Resistance to advice	Attitudes and negative orientation/lack of openness toward recommendations or advice
N3	Provider role	Comments on provider's role
N4	Coordination of care	Mentions or demonstration of coordination of clinic team
O0	Super-structural factors	
O1	Culture	Cultural beliefs or expectations that impact behaviors (e.g., "susto" strong emotions causing diabetes, familism)
O2	Policy	Policies that impact ability to obtain healthcare (e.g., immigration policy, health insurance)
O3	Religion	Discussions of fate (e.g., up to God) or God's will

M.1.2. Example of charting in framework analysis: Health communication themes between CAI women and their health care providers

Themes	CAI women	Health care providers
Cueing event – pregnancy transition	"I guess I wasn't pregnant so I would've never even listened [to dietary recommendations]." "I was putting them [the changes] in practice since my last pregnancy because I already had diabetes for three years, but I took it more seriously since I became pregnant with this other baby. When they told me that my son had the sugar, I put the food [changes] with more rigor. The big difference is that I don't eat greasy foods, and I don't eat much bread or tortilla. We are eating more vegetables and fruits."	I feel that they might be more receptive - that it's a time when they are more receptive to change because - they are changing already. Their body is changing, their life is changing. I think that pregnancy is definitely a good opportunity to either find women motivated or help to motivate change because…the GDM patients who or the diabetic patients who could remember being well-controlled in pregnancy, I think yeah, it's a time when you're more apt to maybe care more for what you're eating and hopefully make them be lifestyle changes."
Dietary beliefs during pregnancy	I think that if you eat healthy the baby will be born healthy…it helps a lot. "The diet –if I am not on it – it's no more than if I say: 'I don't care, I am going to eat a lot of…sweets…a lot of sweet bread'… Then, in the future, when my son is born, he can be very large, or he can be diabetic…If I don't take care at this moment in time." "My brothers look at my plate…want me to eat double for her and for me, and I tell them it's pure myth. The internet said it's a myth." "I don't eat a vegetable! So I know I'm unhealthy and I'm always getting sick. And I believe that's cause, cause of my diet."	"a diabetic diet that I am familiar with is a healthy way to eat and we should all be eating that way and we should all be really conscious of our sugar consumption" "…they are very open to take care of the baby and make changes even if it's just for 9 months they would do everything, most of them. There are exceptions, but if you tell them it's gonna be good for the baby, they will say ok, I'm going for it. So it's more easy for me to talk about portion control with pregnant women." "I tell them it's not like eating for two. It's just eating an extra small meal or 1 snack a day." "…a huge thing for our population base pregnant or not is increasing vegetables."
Sources of sugar and its effect on blood glucose	"It surprised me because I thought that fruits did not have sugar and that's what I eat the most of…in the morning. I eat a banana… sometimes five in a day. I like them a lot and now I can only eat half of a banana." "The things that one doesn't think are sweet, [the provider] says to avoid a lot of bread, because in fact bread contains sugar."	"…she thinks that since it's just fruits, and everything is healthy, it wouldn't hurt her." "..the main problem is that they say that they don't understand the sources of their high sugar, and that's where I see is most of the problem, not in the wanting to change their behavior, but in the lack of recognizing what is causing it."
Portion control	"After breakfast I can eat one portion of fruit…and later in the afternoon or	"…you want to give them the options, or you used to have this every day, but now

	evening I can eat another portion of fruit, two portions a day and no more." "They told me that I have to eat, for example: if I eat four or five tortillas, I need to eat fewer! Two! Little by little – and if I eat rice, I don't need to eat tortilla…"	you try to do it three times per week, let's see what happens, and then another two weeks, it happens, or something like that. So they are more open at making little changes, rather than just stopping, stopping everything."
Balancing food groups	"They told me I could eat at lunch, at dinner…I can eat one portion-two portions of flour, I could eat two tortillas, or one tortilla with a little bit of rice. And the protein always has to be there." "Everything that I like to eat, it's all bad for me." "For me it was a sacrifice because it was like being on a diet…to be on a diet is to be healthy, but we say that we are on a diet because we can't eat the things that we like."	"it's not just what you're eating it's how you're combining it. So as much pictures as I can show, I show." "…the trouble with diet is that there's a lot of don'ts in diet, and as much as possible I try to emphasize the "dos" - what *can* you eat, what do you enjoy? And try to work around that because you know "Don't eat sodas, you can't have coffee, you can't have and you know it gets a little discouraging sometimes."
Altered meal pattern	"We talked about what I should eat for my diabetes…I should eat less at breakfast …because at breakfast my sugar rises higher."	"[Hispanics] love to have like a big, big, huge breakfast, then lunch is going to be smaller, but then dinner is gonna be even smaller, and then if you are diabetic you can't do that. So saying "Ok, you have to make sure you have your 5 kind of meals… 3 meals and then 2 snacks."
Self-efficacy for healthy eating	It will not help me at all to take medicine because I already have the medicine. Any person has to eat healthy to avoid something, it's just that I'm at higher risk of having it and I have to put in more effort…Everything that I told you about small quantities and doing the exercises because there is no one medicine that they say: "You can just take four Tylenol and it goes away", because it's not like that. "I feel like my stomach is empty. I eat but I feel like, when I finish eating, right when I finish eating and move the plate away, I see bread and I say 'Ok I am going to eat one.'"	"…highlighting small changes I think so "Wow, tell me how you did that?! And um, really building off of the skills that *they* have in helping to…help *them* to recognize the skills that they have and times when they *have* had successes. And it's very basic motivational interviewing." I always ask them "Tell me what you eat and tell me what do you think is healthy, and tell me what do you think you could eat"… depending on the answers I would say yes, no, or …you can change for this and they're like "Oh ok…I'm gonna give it a try."
Healthy weight beliefs	"I would like to exercise because I want to maintain a normal weight and it is better for my health. I believe that exercise and health are combined. In order to have good health, one needs to exercise and eat healthy."	"…a very like friendly way you…start like a conversation without saying "because you are obese" …not using those words like obese, or "you're sick" or "your diabetes" no just talking "How are you feeling?" How are you doing?" Good. "Do you have any questions for me?"

Weight gain in pregnancy	"…I've been gaining too much weight since the first months and I'm going to gain much more in the last months. I needed to eat less…and it's helping me a little…the diet they put me on for diabetes…how I should eat less, it helps me not to gain much." "As one has more children, one becomes even fatter. Before I was very thin." "It depends on what one weighs, I think, before becoming pregnant. They [providers] told me some…normally 20 pounds is what one should gain when one is pregnant, and I have gained thirty pounds and I still have a little…about one more month."	"…often midwives get worried about rapid weight gain we see like early 2nd trimester like… 14, 15, 16 weeks, suddenly this patient could have gained like 20 pounds. I'll get like quite a few handoffs for patients like 18 pound weight gain" "…I'm like really overweight anyways, of course I'm gonna keep gaining weight. But, and I was really talking to her about like you know, "Well what does this do to your *baby?* And what about in *labor* because… it's really, really, *really* hard when you're overweight, so I will like talk about that and they're like "Yeahhh [agreement]"
Knowledge about later diabetes risk	"Well I carry risk because of my mother, since I can inherit it. Therefore, I have to take care of myself from now on, because there is the possibility that I can develop it due to heredity. Because she has it, they told me I have to take care." "Now supposedly I don't have it, but I have to be careful with my diet so that I don't develop diabetes...not gestational diabetes but the normal one." "Some women 3 or 5 years after [pregnancy] already develop regular diabetes."	I want to stress to them that if they have already a higher risk than most people, they and their families can be in a really bad situation in the future, in the close future. I've had actually - because I've worked here for 13 years already, quite a few patients that were GDM that are now diabetics. Yes some of them even as short as 3 years, already developed diabetes. "Risk is a word…not everybody has a good grasp on…it's too abstract…they don't grasp their risk because there's nothing that they can see, touch, or feel."
Gestational diabetes resolution	"…in the last days that I have left until the baby, it could disappear and then I will no longer have diabetes when the baby is born. I will no longer have diabetes, and I will continue my life as normal, only that I must be careful with the sugar, not eat it too much. But when the baby is born, maybe the diabetes will be gone."	"…most of them think, this is not forever, this is going to be *just* until I have the baby, this is not going to last. And most of the time it doesn't - but I think that is one key that helps- when they find out that 'uh-oh I'm one of the ones this is going to stay for the rest of my life' *that* sometimes is the bigger challenge."
Self-efficacy for diabetes prevention	"…you can, not sure if it's 100%, but you can prevent it; you can prevent diabetes when you eat healthy."	"[I tell them] following the diet may not totally eliminate that [future diabetes] from ever happening, but if anything it will probably at least postpone it a bit."
Motivation for behavior change	"I have to take better care of myself for my own good and that of my baby. In my house I also need to take better care of my children that are a little fat." "For this, I always need to eat healthy to prevent diabetes in the future and	"…they say it's really hard, and I get hungry, and but I'm doing it because the baby is my motivation and I want my baby to be healthy. So if they put the same commitment after the baby is born, that's total gain for all of us…"

	that's how I can control it. After [delivery] I will continue eating the same to prevent it."	"…they are gonna change the way they eat, they are even gonna force themselves to even if they never did. You tell them you're gonna help the baby, it's a great moment for people to make changes in this time."
Activate social role	"Well because I don't want to be sick, and I don't want to have anything - I don't want to die! Because I want to see my girls grow up and so…I want to be very healthy for them." The important thing when one is cooking is to think not only of yourself but the whole family as well, because if you care about your family, you will not want them to be sick. The children must record in their minds that they have to eat healthy for the future and for themselves. If we were taught the importance of eating healthy, of how to eat vegetables, we would have an idea of how to eat better.	"…you have to be healthy in order to take care of your baby too." "…'This isn't just you who this nutrition we're talking about, this is for everyone…this is healthful eating, this isn't just a diet'." "Nutrition is one of those really important jobs that we have as parents and reminding parents of that because…we're thinking about keeping our kids safe…but nutrition is also one of the really important things we can teach our kids how to eat well, we can teach them dishes that are special to our family, and our culture, and focusing on that as well is important."
Changing self-concept	"I am most excited because this is my first baby and I am happy…I feel like…I am formalizing myself…becoming more committed to my baby. Working for, having a reason for whom to work."	"it's [identity change] something that comes up in the prenatal classes and we talk about and do like some roleplaying with emotional changes in pregnancy….our identity *does* change when we have babies…"
Decision making about self-management	"I don't treat eating like it's a game and instead take it more seriously now, because if one already has a developed illness, it means that if one does not take care of oneself, there is the risk that one could die and no longer be with her family."	"… it's not easy to look into the long term future … what I talked about a *lot* unfortunately was like "What are the complications?" and then "Imagine, yes this does feel like an added cost, but the reality is it's probably 10 or 15 dollars, and what does it cost to be sick? And you can't watch your *grandchildren* because you're not able to get up, or you're in the hospital".
Temporal salience/ personal susceptibility	"Mainly it's all her [the baby]. I guess I was really immature before. I'm only 20 so before I wasn't too worried, I'm like "If I'm gonna get sick, I'm gonna get sick when I'm 40 or 50." Now I'm thinking about it and no, it could happen now, 'cause I almost had diabetes." "I used to think you can get breast cancer and diabetes and all of that later…but now I see that no, diabetes it's really close to me right now."	I try to give them um anecdotals of other patients, because they tend to internalize more if they know that there is an actual person that has had these problems. If I talk to them about risk in general, they don't see it cause it said that diabetes is a disease of elderly people and if they are in their 20s or 30s they won't feel so stressed out about developing diabetes 30 years from now.

M.1.3. Provider interview guide

Provider interview guide

Role of provider

I understand that the Mary's Center team includes many different providers with different roles that work within the framework of health promotion. To start, I'd like to know more about how you see your role as a provider.

- Please tell me about what you do at Mary's Center and some of your main responsibilities.
- Tell me about the kinds of people you see. (Probe: Pregnant and non-pregnant?)
- What kinds of stories do they tell you about themselves?

Lifestyle counseling

Now I'd like to focus on your interactions with the patients you see. I don't want to know the name or anything that would allow me to know who you are talking about. I'm interested in knowing more about how you talk with your clients about nutrition and exercise and if this conversation is part of your visits.

- How do you 'typically' counsel patients on these issues? When it comes up, how do you address it?

- Please think of a visit where you were able to provide counseling and think it went well. Tell me what happened during that visit. (Probe for the story, narrative)
  Probes:
  - Can you share a little about that patient or the situation that you think made the visit go well?

1) Please think of a visit where counseling didn't go well, or you didn't have a chance but would have liked to provide more counseling. Tell me what happened during that visit.
   Probes:
   - Why didn't it go well (patient-level, system-level, provider-level barriers)?
   - What do you think would have helped it go better?

2) Please tell me about a conversation you had with a woman with newly diagnosed GDM where you discussed what was going on with her.
   Probes:
   - How do you explain the diagnosis of GDM to a patient?
   - How do you explain what happens after pregnancy/delivery to continue to stay healthy?
   - How and when do you talk about diabetes risk and risk reduction strategies?
   - What questions or concerns do women express to you?

3) What kinds of dietary recommendations do you make to your clients? What factors influence what you recommend?
   Probes:
   - How might your recommendations differ over the course of the pregnancy?
   - What recommendations about diet do you make for women with GDM compared with non-GDM patients?

4) In your experience, how have women responded to the information you provide about food or diet? What are some reasons that you think they do or do not comply?

Thank you for sharing your experiences in speaking with your clients.

Teachable moments

You have a lot of experience working with the population here.

- In your opinion, to what extent are your clients motivated to learn about or make healthy dietary changes?
- What would motivate people to change health behaviors? Any turning points or moments?

I am interested in whether pregnancy can be a teachable moment for healthy lifestyle change. What I mean by this is whether pregnancy can provide an opportunity to promote healthy eating over the long-term, both for women with average risk of diabetes and those with GDM.

5) In your experience, what makes the period during pregnancy a good or bad time to engage women about diet and diabetes prevention?

6) What have you found to be the best teachable moments? (Probes: At what points? During pregnancy? During prenatal care? Other programs?)

7) Can you think of ways we could improve the opportunity in Mary's Center to engage women in healthier eating over the long-term?
   Probes: How about at…
   - Other community or public health services?
   - Anything else that comes to mind?
   - To what extent do you think that other providers involved in care of pregnant patients can work together? How do you see your roles? (Nutritionist, health promotion, midwives, diabetes educators, centering pregnancy?)

Now that we've talked about your conversations with patients about diet and diabetes, I'd like to focus more generally on the experience of pregnant patients and their family interactions.

Identity and social roles

I am interested in the way your patients talk about their own changing roles or changes in the family as a result of pregnancy and becoming a mother.

- Can you tell me the story of a client where she discussed this transition?
  Probes:
  - How do patients talk about their relationship with their partner?
  - With other family members or friends?

Probe for other stories, or contrasting stories, here – and from earlier in interview.

Formative patient guide

Lastly, I will be interviewing patients to learn about their experiences with the foods they eat and about diabetes.

- What questions do you have for patients that you would most like to know about?

We've come to the end of the interview. What else you would like to mention about what we've covered?

Thank you so very much for your time. We ask that, to the extent possible, you do not discuss this interview with your colleagues until the end of this study, since we would like to obtain the unique perspectives of different providers through these interviews. Thank you again for being here and helping us with this research.

M.1.4. Initial interview guide (Spanish) – CAI women

Guía de entrevista (inicial) de una paciente

Según la descripción en el formulario de consentimiento, queremos aprender más sobre su experiencia durante el embarazo, sobre los alimentos que Ud. y su familia consumen, y sus pensamientos sobre los temas de salud.

El contexto

1) Me gustaría hacerle algunas preguntas para conocerla mejor.

   - ¿Cómo se siente hoy?
   - Por favor cuénteme algo sobre su familia (*Sugerencia*: ¿Es su primer hijo? ¿Cuántos niños tiene?
   - ¿Cuánto tiempo lleva de embarazo? (*Sugerencia*: ¿Cuantas semanas?)
   - ¿Cómo ha estado? ¿Hubo alguna complicación?

Identidad y papel social

2) Me gustaría hablar más sobre éste embarazo.
   - ¿Cómo le ha ido con el embarazo hasta ahora?
   - ¿Cómo está su salud?
   - ¿Qué cambios ha tenido durante este embarazo? (La comida y los alimentos)
   - Descríbame un día común (sus horarios, actividades, etc).
     - ¿Qué hace con su familia?
     - ¿Describe sus responsabilidades con su familia? Trabajo?
     - ¿Cómo se imagine que cambiarán sus responsabilidades al tener su bebe?
   - ¿Qué le emociona más sobre estar embarazada? Sobre hacerse madre?
   - ¿Qué le preocupa más sobre estar embarazada? Sobre hacerse madre?
   - ¿Cuál será el cambio más ***emocionante*** que este bebé/niño traerá a su familia?
   - ¿Cuál será el cambio más ***preocupante*** que este bebé/niño traerá a su familia?

La comida durante el embarazo

3) Me gustaría hablar con Ud. sobre la comida y su alimentación durante el embarazo.
   - ¿Cuáles son algunas comidas o bebidas que piensa Ud. que son saludables para comer durante su embarazo? *(Por favor, cuénteme más sobre eso).* ¿Cuáles son algunas comidas o bebidas que piensa Ud. que necesita evitar durante su embarazo?

     Sugerencias:
     - ¿Cómo o de quien oyó /escuchó sobre lo que debe comer? ¿Durante su embarazo? (¿Consejos de su familia?)
     - ¿Cuáles son remedios caseros durante el embarazo?

- ¿Ha cambiado en algo su hábito alimenticio desde que está embarazada? C*ó*mo ha cambiado? *Si cambió:* ¿Qué la hizo hacer estos cambios? C*ó*mo siente al respecto a estos cambios?

  Sugerencias:

  - ¿Qué comi*ó* ayer? ¿Durante el fin de semana? Que desayunó? Almorzó? Cenó? Estas comidas son típicas para Ud.? ¿(Está acostumbrada a comer estas comidas)? ¿Y sobre la comida de su familia?
  - ¿C*ó*mo piensa que su familia reaccionaría a estos cambios?
  - ¿Qué es lo que Ud. come ahora que no comía antes? (De hace 5 años? De hace 10 años?)
  - ¿Cuáles son las mayores diferencias alimentares entre lo que Ud. comía antes en su país y lo que qué come actualmente?
- Piense en una ida al mercado. (Por favor, cuénteme que considere cuando escoge lo que comprar. ¿Cuáles son los factores más importantes?)
  - En su familia, quién va al mercado o supermercado típicamente? ¿Ad*ó*nde va? ¿Quién prepara las comidas? ¿Qué le gusta preparar?
- ¿Qué información o sugerencias sobre la comida o suplementos/vitaminas ha oído?
  - ¿Qué ha oído sobre las comidas que debe comer durante el embarazo? ¿C*ó*mo se siente Ud. sobre la sugerencia? (¿De proveedores de Mary's Center?)
  - ¿C*ó*mo influirá en su salud y la de su bebé los alimentos que Ud. come?
  - ¿C*ó*mo planea comer en el futuro?

Nutrici*ó*n federal benéfica

4) Me gustaría saber más sobre cualquier tipo de programa de asistencia nutricional Ud. decidió registrase (ej.WIC, SNAP, almuerzos o desayunos escolares).
   - ¿Puede contarme sus experiencias con estos programas? ¿Qué encuentra útil y que problemas podría tener?

     Sugerencias:

     - ¿Haste que nivel los programas han cumplido sus necesidades?
     - ¿Qué compra típicamente con los beneficios?
     - ¿En un mundo ideal, en que le gustaría gastar este dinero? (¿Cuáles comidas le gustaría comprar que actualmente Ud. no puede?)
     - ¿Qué parte de los servicios funcionan mejor?
     - ¿C*ó*mo podrían mejorar estos servicios?

Riesgos de diabetes

5) Ahora me gustaría hablar sobre la diabetes y lo que ha escuchado sobre la condición.

   - ¿Qué ha oído sobre la diabetes? ¿La diabetes durante el embarazo? (*Sugerencias: Azúcar en la sangre, gestacional*)

- Para non-GDM: Por favor cuéntame sobre una visita en Mary's Center donde aprendi*ó* (ha oído algo) sobre la diabetes gestacional o azúcar en la sangre. ¿C*ó*mo la hizo sentir?
- Para GDM: Por favor cuéntame sobre la visita en Mary's Center donde Ud. supo que tenía la diabetes gestacional o azúcar en la sangre. ¿C*ó*mo la hizo sentir? ¿Qué le preocupó más? ¿Qué tipos de cambios ha considerado Ud. desde que supo sobre esto? (*Sugerencia*: Cambios en comportamiento)
- Por favor cuéntame lo que ha oído sobre los riesgos de tener diabetes. (*Sugerencias*: GDM, t2DM)

  Sugerencia:
  - ¿Con quién ha hablado sobre la diabetes?
  - ¿Qué le han dicho los proveedores en Mary's Center sobre la diabetes? (Partera o comadrona, nutricionista, promotoras de salud, educadores de clases de "Centering", educadores prenatales)
  - ¿C*ó*mo se sentía sobre las recomendaciones? ¿Cree que Ud. puede hacer los cambios que recomendaron? *No: ¿Por qué no lo cree? Si: Que haría para realizar estos cambios?*
- ¿Qué cree que sea su propio riesgo a desarrollar la diabetes? ¿Qué aumenta sus posibilidades?

  Sugerencia:
  - ¿Durante el embarazo? ¿Después del embarazo? Por favor cuénteme sobre esto.
  - ¿Tiene Ud. familia con diabetes?

Transici*ó*n

6) Gracias por compartir muchas de sus experiencias. Ahora me gustaría saber más sobre su historia y su vida.
   - ¿De qué país es Ud. y su familia?
   - ¿Cuantos años ha vivido en los Estados Unidos? ¿Naci*ó* en los Estados Unidos?
   - ¿C*ó*mo fue su experiencia al mudarse aquí?

Llegamos al fin de esta entrevista. ¿Qué más le gustaría decir sobre lo que hemos hablado?

Muchas gracias por su tiempo en ayudarnos a comprender sus experiencias durante el embarazo.

M.1.5. Initial interview guide (English) – CAI women

Patient interview guide (initial)

As we described in the consent document, we would like to learn more about your experiences during pregnancy, about the foods you and your family eat, and your thoughts about health issues.

Background

8) I'd like to ask you some questions to get to know you better.

- How are you feeling today?
- Tell me about your family. (Probes: Is this your first child? How many children do you have?)
- How far along in pregnancy are you? How many weeks?
- How has it been going for you so far? (Probe: Complications?)

Identity and social roles

9) Now I'd like to talk more about this pregnancy.
   - How has the pregnancy been going?
   - How is your health?
   - What changes have you made during this pregnancy? (Probe: Eating and foods)
   - Tell me about what you usually do during the day.
     1. What do you do with your family?
     2. How do you describe your responsibilities to your family? Work?
     3. How do you imagine your responsibilities would change once you have a new baby?
   - What *excites* you the most about being pregnant? About becoming a mother?
   - What *worries* you the most about being pregnant? About becoming a mother?
   - What are you most *excited* about for the changes in your family that a new baby will bring?
   - What are you most *worried* about for the changes in your family that a new baby will bring?

Eating during pregnancy

10) I'd like to talk about foods and eating during your pregnancy.

- What are some foods/drinks that you think are good for you to eat during pregnancy? (Please tell me more about that). What are some foods/drinks that you think you should avoid?

  Probes:

  - Where or from whom did you hear about how to eat? During pregnancy?

- How, if at all, have the foods you eat changed since becoming pregnant? If changed: What made you make these changes? How do you *feel* about making changes?
  Probes:
  - What did you eat yesterday? Last weekend? Breakfast? Lunch? Dinner? Are these typical meals for you? What about the foods your family eats?
  - How do you think your family would react to changes?
  - How is what you eat now different from before? (Prompts: 5 years ago? 10 years ago?)
- Think about a trip to the grocery store. Please talk about what you think about when you decide what to buy. What are the most important factors?
  Probes:
  - In your family, who typically shops? Where? Who prepares meals? What do you/they like to make?
- What information or advice about food or supplements have you heard?
  Probes:
  - What have you heard about foods you should eat during pregnancy? How do you feel about that advice? (Providers at Mary's Center?)
  - How do the foods you eat impact your health and your child's health?
  - How do you plan to eat in the future?

Federal nutrition benefits

11) I'd like to learn more about what types of food assistance programs you participate in, such as WIC, SNAP, school breakfasts/lunches.

- Can you tell me about your experiences with these programs such as what you find useful and problems you may have with them?
  Probes:
  - How well do the programs meet your needs?
  - What do you typically buy with these benefits?
  - In a dream world, what would you like to spend this money on? (What foods would you like to buy but cannot?)
  - What are the parts of these services that work best?
  - How could these services be improved?

Diabetes risk

12) Now I'd like to talk about diabetes and what you have heard about the condition.

- What have you heard about diabetes? Diabetes during pregnancy? (Probe: Sugar in the blood, gestational)
- *<u>For non-GDM</u>:* Please tell me about the visit at Mary's Center where you learned about gestational diabetes or sugar in the blood. How did it make you feel?
- *<u>For gestational diabetics</u>:* Please tell me about the visit at Mary's Center where you learned you had gestational diabetes or sugar in the blood. How did you feel? What

were you most worried about? What kinds of changes have you considered since knowing about it? (Probe: Behavior change).

- Please tell me what you have heard about risks for getting diabetes (Probes: GDM, t2DM).

  Probes:

  - Who have you spoken with about diabetes?
  - What have providers at Mary's Center said about diabetes (Midwife, Nutritionist, Health promotion, Centering pregnancy classes/pre-natal care?)
  - How did you feel about their recommendations? Do you think you could make the changes they recommended, and if so, why?

- What do you think is your own risk of developing diabetes? What increases your chances?

  Probes:

  - During pregnancy? After pregnancy? Tell me more about this.
  - Have you had family members with diabetes?

Transitions

13) Thank you for sharing so much about your experiences. Now I'd like to know a little more about your history and background.

- What country are you/your family from?
- How long have you lived in the US? (Were you born in the US?)
- What was it like to move here?
- How is what you eat here different from what you ate back home (If moved to the US)?

We've come to the end of the interview. What else would you like to mention about what we've covered?

Thank you so very much for your time and helping us to better understand your experiences during pregnancy.

M.1.6. Follow-up interview guide (Spanish) – CAI women

Entrevista de seguimiento de una paciente

Según la descripción en el formulario de consentimiento, queremos aprender más sobre su experiencia durante el embarazo, sobre los alimentos que Ud. y su familia consumen, y sus pensamientos sobre los temas de salud.

El contexto

1) Me gustaría hacerle algunas preguntas para saber c*ómo* esta Ud.
    - ¿C*ó*mo se siente hoy?
        - ¿Generalmente, c*ó*mo ha estado estos días?
    - ¿Cuántas semanas tiene su bebé?
    - Me gustaría preguntarle un poco sobre su bebé y su parto. ¿Cómo fue el parto? (*Sugerencia*: ¿Hubo alguna complicación?)
        - ¿Cuánto peso tuvo el bebé al nacer?
    - *Para mujeres con GDM*: Por favor cuénteme sobre sus experiencias con la diabetes gestacional. ¿C*ó*mo ha sido? ¿C*ó*mo ha sentido?

Identidad y papel social

2) Ahora me gustaría hablar generalmente sobre su experiencia como madre, posparto.
    - ¿Cómo se siente estos días?
    - Descríbame un día común (sus horarios, actividades, etc).
        - ¿Qué hace con su familia?
        - ¿Describe sus responsabilidades con su familia? Trabajo?
        - ¿C*ó*mo han cambiado sus responsabilidades desde tener el bebé?
    - ¿Qué le emociona más sobre hacerse madre?
    - ¿Qué le preocupa más sobre hacerse madre?
    - ¿Cuál es el cambio más ***emocionante*** que este bebé trae a su familia?
    - ¿Cuál es el cambio más ***preocupante*** que este bebé trae a su familia?

Seguimiento: La última vez que hablamos, me dijo que xxx. Cómo siente sobre esto ahora?

La comida después del parto

3) Me gustaría hablar sobre la comida y su alimentación, ahora que Ud. está en casa con su bebe.
    - ¿Qué tipos de comidas y bebidas ha estado comiendo, después del nacimiento de su bebe? *(Por favor, cuénteme más sobre eso).* ¿Son diferentes de qué comía antes? *Si cambió:* ¿Qué la hizo hacer estos cambios? ¿C*ó*mo siente al respecto a estos cambios? ¿Cómo planea comer en el futuro?

      Sugerencias:
        - Dar de mamar? Dar pecho? Lactancia materna? Preocupaci*ó*n sobre el peso?

    - Qué comi*ó* ayer? ¿Durante el fin de semana? Que desayunó? Almorzó? Cenó? Estas comidas son típicas para Ud.? ¿(Está acostumbrada a comer estas comidas)? ¿Y sobre la comida de su familia?
    - ¿C*ó*mo piensa que su familia reaccionaría a estos cambios?
    - ¿Ud. Ha utilizado remedios caseros posparto? ¿Cuáles? (¿Fueron consejos de su familia?)
- Piense en una ida al mercado. (Por favor, cuénteme que considere cuando escoge lo que comprar. ¿Cuáles son los factores más importantes?)

    Sugerencias:
    - ¿Quién compra (va al mercado o supermercado) en estos días? ¿Ad*ó*nde va? ¿Quién prepara las comidas y que le gusta preparar?
    - ¿Qué le gusta preparar?
- ¿Qué información o sugerencias sobre la comida o suplementos/vitaminas ha oído?

    Sugerencias:
    - ¿Qué ha oído sobre las comidas que debe comer posparto? ¿C*ó*mo siente Ud. sobre los consejos? (¿De proveedores de Mary's Center? Familia?)
    - ¿C*ó*mo influirá en su salud y la de su bebé los alimentos que Ud. come? Amamantar?

Nutrici*ó*n federal benéfica

4) Me gustaría saber más sobre cualquier tipo de programa de asistencia nutricional Ud. decidió registrase desde que nació su bebé (ej.WIC, SNAP, almuerzos o desayunos escolares).
    - ¿Basado en *[lista de programas dicha por la entrevistada durante la primera entrevista],* cuales programas utiliza Ud. todavía? ¿Ha registrado en nuevos programas desde que nos encontremos?
    - ¿Puede contarme sus experiencias con estos programas? ¿Qué encuentra útil y que problemas podría tener?

        Sugerencias:
        - ¿Haste que nivel los programas han cumplido sus nuevas necesidades, después de haber tenido un bebé?
        - ¿C*ó*mo han cambiado sus necesidades desde tener su bebé?
        - ¿Qué compra típicamente con los beneficios?
        - ¿En un mundo ideal, en que le gustaría gastar este dinero? (¿Cuáles comidas le gustaría comprar que actualmente Ud. no puede?)
        - ¿Qué parte de los servicios funcionan mejor?
        - ¿C*ó*mo podrían mejorar estos servicios?

Riesgos de diabetes

5) Ahora me gustaría hablar sobre la diabetes y lo que ha escuchado sobre la condición.

    - <u>Para GDM:</u> ¿Después del embarazo, ha sido Ud. examinado para la diabetes?
        - Si lo ha sido examinado, ¿cuándo? ¿Cuál fue el resultado del examen?

    - Por favor cuéntame cómo se sintió cuando supo los resultados del examen (al aprender que tenía la diabetes o azúcar en la sangre). ¿Cómo la hizo sentir? ¿Qué le preocupó más?
    - ¿Qué tipos de cambios ha considerado Ud. desde que supo sobre esto? (*Sugerencia*: Cambios en comportamiento)
- ¿Desde la última vez que nos reunimos, ha aprendido nueva información sobre los riesgos de la diabetes? (*Sugerencias*: GDM, t2DM) ¿Ha cambiado éstos desde la última vez que hablamos?

  Sugerencia:
    - ¿Qué le han dicho los proveedores en Mary's Center sobre la diabetes? (Partera o comadrona, consultas de la lactancia, nutricionista, promotoras de salud, educadores de clases de "Centering", educadores prenatales)
    - ¿Cómo se sentía sobre las recomendaciones? ¿Cree que Ud. puede hacer los cambios que recomendaron? *No: ¿Por qué no lo cree? Si: Que haría para realizar estos cambios?*
- ¿Qué cree que sea su propio riesgo a desarrollar la diabetes? ¿Cómo ha cambiado éste desde la última vez que hablamos?

  Sugerencia:
    - ¿Durante un futuro embarazo? ¿Más adelante en el futuro? Por favor cuénteme sobre esto.

Llegamos al fin de esta entrevista. ¿Qué más le gustaría decir sobre lo que hemos hablado?

Muchas gracias por su tiempo en ayudarnos a comprender sus experiencias posparto.

M.1.7. Follow-up interview guide (English) – CAI women

Patient interview guide (follow-up)

As we described in the consent document, we would like to learn more about your experiences after delivery, about the foods you and your family eat, and your thoughts about health issues.

Background

1) I'd like to ask you some questions to see how you're doing.

- How are you feeling today?
    - In general, how are things going for you these days?
- How many weeks old is your baby?
- I'd like to ask you a little about your baby and delivery. How was the delivery? (Probe: complications)
    - What was the birth weight of your baby?
- For women with GDM: Please tell me about your experience with gestational diabetes. What has it been like? How have you felt?

Identity and social roles

2) Now I'd like to talk more generally about your experience after delivery, as a mother.
    - How do you feel these days?
    - Tell me about what you usually do during the day.
        1. What do you do with your family?
        2. How do you describe your responsibilities to your family? Work?
        3. How have things changed now with the baby?
    - What *excites* you the most about being a mother?
    - What *worries* you the most about being a mother?
    - What are you most *excited* about for the changes in your family that the new baby brings?
    - What are you most *worried* about for the changes in your family that the new baby brings?

Follow-up probes: The last time we spoke, you mentioned x. How do you feel about that now?

Eating after delivery

3) I'd like to talk about foods and eating now that you're home with your baby.

- What kinds of foods have you been eating now, after giving birth? To what extent are they different from what you ate before? If changed: What made you make these changes? How do you *feel* about making changes? How do you plan to eat in the future?

Probes:

- Breastfeeding? Concerns about weight?
- What did you eat yesterday? Last weekend? Breakfast? Lunch? Dinner? Are these typical meals for you? What about the foods your family eats?
- How do you think your family would react to changes?

- Think about a trip to the grocery store. Please talk about what you think about when you decide what to buy. What are the most important factors?

  Probes:

  - These days, who shops? Where? Who prepares meals? What do you/they like to make?
- What information or advice about food or supplements have you heard?

  Probes:

  - What have you heard about foods you should eat now? How do you feel about that advice? (Providers at Mary's Center?)
  - How do the foods you eat impact your health, breastfeeding, and your child's health?

Federal nutrition benefits

4) Since having your baby, I'd like to learn more about what types of food assistance programs you participate in, such as WIC, SNAP, school breakfasts/lunches.

- Based on *[list of programs they reported during first interview]* which programs are you still on? Have you joined any new programs since we last talked?
- Can you tell me about your experiences with these programs such as what you find useful and problems you may have with them?

  Probes:

  - How well do the programs meet your needs now that you have a baby?
  - How have your needs changed since having the baby?
  - What do you typically buy with these benefits?
  - In a dream world, what would you like to spend this money on? (What foods would you like to buy but cannot?)
  - What are the parts of these services that work best?
  - How could these services be improved?

Diabetes risk

5) Now I'd like to talk about diabetes and what you have heard about the condition.

- <u>*For gestational diabetics*</u>*:* After pregnancy, have you been tested for diabetes?
  - If so, when? What was the result of the test?
  - Please tell me about how you felt when you heard the results of your test. What are you most worried about?
  - What kinds of changes have you considered since knowing the result? (Probe: Behavior change).

- Since we last met, have you learned any new information about the risks of getting diabetes? Have these changed since the last time we talked?
  Probes:
  - What have providers at Mary's Center said about diabetes (Midwife, Nutritionist, Health promotion, Lactation consultants?)
  - How did you feel about their recommendations? Do you think you could make the changes they recommended, and if so, why?
- What do you think is your own risk of getting diabetes? How might this have changed since the last time we talked?
  Probes:
  - During a future pregnancy? Later in life? Tell me more about this.

We've come to the end of the interview. What else would you like to mention about what we've covered?

Thank you so very much for your time and helping us to better understand your experiences after pregnancy.

M.2: Bibliography

1. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2012; **35 Suppl 1**: S64-71.

2. Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, Damm P, et al. International association of diabetes and pregnancy study groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. Diabetes Care. 2010; **33**(3): 676-82.

3. Ferrara A. Increasing prevalence of gestational diabetes mellitus: a public health perspective. Diabetes Care. 2007; **30 Suppl 2**: S141-6.

4. Ben-Haroush A, Yogev Y, Hod M. Epidemiology of gestational diabetes mellitus and its association with Type 2 diabetes. Diabet Med. 2004; **21**(2): 103-13.

5. Karakosta P, Alegakis D, Georgiou V, Roumeliotaki T, Fthenou E, Vassilaki M, et al. Thyroid Dysfunction and Autoantibodies in Early Pregnancy Are Associated with Increased Risk of Gestational Diabetes and Adverse Birth Outcomes. J Clin Endocrinol Metab. 2012.

6. Bellamy L, Casas JP, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. Lancet. 2009; **373**(9677): 1773-9.

7. Kim C, Newton KM, Knopp RH. Gestational diabetes and the incidence of type 2 diabetes: a systematic review. Diabetes Care. 2002; **25**(10): 1862-8.

8. England LJ, Dietz PM, Njoroge T, Callaghan WM, Bruce C, Buus RM, et al. Preventing type 2 diabetes: public health implications for women with a history of gestational diabetes mellitus. Am J Obstet Gynecol. 2009; **200**(4): 365 e1-8.

9. Ferrara A, Ehrlich SF. Strategies for diabetes prevention before and after pregnancy in women with GDM. Curr Diabetes Rev. 2011; **7**(2): 75-83.

10. Bennett WL, Robinson KA, Saldanha IJ, Wilson LM, Nicholson WK. High priority research needs for gestational diabetes mellitus. J Womens Health (Larchmt). 2012; **21**(9): 925-32.

11. Ratner RE, Christophi CA, Metzger BE, Dabelea D, Bennett PH, Pi-Sunyer X, et al. Prevention of diabetes in women with a history of gestational diabetes: effects of metformin and lifestyle interventions. J Clin Endocrinol Metab. 2008; **93**(12): 4774-9.

12. Hedderson M, Ehrlich S, Sridhar S, Darbinian J, Moore S, Ferrara A. Racial/ethnic disparities in the prevalence of gestational diabetes mellitus by BMI. Diabetes Care. 2012; **35**(7): 1492-8.

13. Cabellero AE, Tenzer P. Building cultural competency for improved diabetes care: Latino Americans and diabetes. J Fam Pract. 2007; **56**(9 Suppl Building): S7-13.

14. Chasan-Taber L. Physical activity and dietary behaviors associated with weight gain and impaired glucose tolerance among pregnant Latinas. Adv Nutr. 2012; **3**(1): 108-18.

15. Tovar A, Must A, Bermudez OI, Hyatt RR, Chasan-Taber L. The impact of gestational weight gain and diet on abnormal glucose tolerance during pregnancy in Hispanic women. Matern Child Health J. 2009; **13**(4): 520-30.

16. Sussner KM, Lindsay AC, Greaney ML, Peterson KE. The influence of immigrant status and acculturation on the development of overweight in Latino families: a qualitative study. J Immigr Minor Health. 2008; **10**(6): 497-505.

17. Bowie JV, Juon HS, Cho J, Rodriguez EM. Factors associated with overweight and obesity among Mexican Americans and Central Americans: results from the 2001 California Health Interview Survey. Prev Chronic Dis. 2007; **4**(1): A10.

18. Purnell L. Guatemalans' practices for health promotion and the meaning of respect afforded them by health care providers. J Transcult Nurs. 2001; **12**(1): 40-7.

19. Murguia A, Peterson RA, Zea MC. Use and implications of ethnomedical health care approaches among Central American immigrants. Health Soc Work. 2003; **28**(1): 43-51.

20. Gloria AM, Peregoy JJ. Counseling Latino alcohol and other substance users/abusers. Cultural considerations for counselors. J Subst Abuse Treat. 1996; **13**(2): 119-26.

21. Terrazas A. Salvadoran Immigrants in the United States 2010 [cited 2013 June 04]; Available from: http://www.migrationinformation.org/USFocus/display.cfm?ID=765#6

22. Buschur E, Kim C. Guidelines and interventions for obesity during pregnancy. Int J Gynaecol Obstet. 2012; **119**(1): 6-10.

23. Hedderson MM, Gunderson EP, Ferrara A. Gestational weight gain and risk of gestational diabetes mellitus. Obstet Gynecol. 2010; **115**(3): 597-604.

24. Brunner S, Stecher L, Ziebarth S, Nehring I, Rifas-Shiman SL, Sommer C, et al. Excessive gestational weight gain prior to glucose screening and the risk of gestational diabetes: a meta-analysis. Diabetologia. 2015; **58**(10): 2229-37.

25. Gante I, Amaral N, Dores J, Almeida MC. Impact of gestational weight gain on obstetric and neonatal outcomes in obese diabetic women. BMC Pregnancy Childbirth. 2015; **15**: 249.

26. Cox Bauer CM, Bernhard KA, Greer DM, Merrill DC. Maternal and neonatal outcomes in obese women who lose weight during pregnancy. J Perinatol. 2016.

27. Academies IoMaNRCotN. Weight Gain During Pregnancy: Reexamining the Guidelines. 2009.

28. Viswanathan M, Siega-Riz AM, Moos MK, Deierlein A, Mumford S, Knaack J, et al. Outcomes of maternal weight gain. Evid Rep Technol Assess (Full Rep). 2008; (168): 1-223.

29. Hutcheon JA, Oken E. Towards Defining Optimal Gestational Weight Gain. Current Epidemiology Reports. 2016: 1-7.

30. Murguia M. Machismo, marianismo, and hembrismo, and their relationship to acculturation as predictors of psychological well-being in a Mexican and Chicano population: University of Wisconsin--Madison; 2001.

31. Zaldivar A, Smolowitz J. Perceptions of the importance placed on religion and folk medicine by non-Mexican-American Hispanic adults with diabetes. Diabetes Educ. 1994; **20**(4): 303-6.

32. Muktabhant B, Lumbiganon P, Ngamjarus C, Dowswell T. Interventions for preventing excessive weight gain during pregnancy. Cochrane Database Syst Rev. 2012; **4**: CD007145.

33. Dodd JM, Crowther CA, Robinson JS. Dietary and lifestyle interventions to limit weight gain during pregnancy for obese or overweight women: a systematic review. Acta Obstet Gynecol Scand. 2008; **87**(7): 702-6.

34. Phelan S. Pregnancy: a "teachable moment" for weight control and obesity prevention. Am J Obstet Gynecol. 2010; **202**(2): 135 e1-8.

35. Althuizen E, van der Wijden C, van Mechelen W, Seidell J, van Poppel M. The effect of a counselling intervention on weight changes during and after pregnancy: a randomised trial. BJOG. 2013; **120**(1): 92-9.

36. Skouteris H, Hartley-Clark L, McCabe M, Milgrom J, Kent B, Herring SJ, et al. Preventing excessive gestational weight gain: a systematic review of interventions. Obes Rev. 2010; **11**(11): 757-68.

37. Tobias DK, Hu FB, Chavarro J, Rosner B, Mozaffarian D, Zhang C. Healthful Dietary Patterns and Type 2 Diabetes Mellitus Risk Among Women With a History of Gestational Diabetes Mellitus. Arch Intern Med. 2012: 1-7.

38. Tobias DK, Zhang C, Chavarro J, Bowers K, Rich-Edwards J, Rosner B, et al. Prepregnancy adherence to dietary patterns and lower risk of gestational diabetes mellitus. Am J Clin Nutr. 2012; **96**(2): 289-95.

39. Jones EJ, Roche CC, Appel SJ. A review of the health beliefs and lifestyle behaviors of women with previous gestational diabetes. J Obstet Gynecol Neonatal Nurs. 2009; **38**(5): 516-26.

40. Webster R, Heeley E. Perceptions of risk: understanding cardiovascular disease. Risk Manag Healthc Policy. 2010; **3**: 49-60.

41. Dickerson JB, Smith ML, Sosa E, McKyer EL, Ory MG. Perceived risk of developing diabetes in early adulthood: beliefs about inherited and behavioral risk factors across the life course. J Health Psychol. 2012; **17**(2): 285-96.

42. Pijl M, Timmermans DR, Claassen L, Janssens AC, Nijpels G, Dekker JM, et al. Impact of communicating familial risk of diabetes on illness perceptions and self-reported behavioral outcomes: a randomized controlled trial. Diabetes Care. 2009; **32**(4): 597-9.

43. Carolan MC, Gill G, Steele C. Women's experiences of factors that facilitate or inhibit gestational diabetes self-management. BMC Pregnancy Childbirth. 2012; **12**(1): 99.

44. Kim C, McEwen LN, Piette JD, Goewey J, Ferrara A, Walker EA. Risk perception for diabetes among women with histories of gestational diabetes mellitus. Diabetes Care. 2007; **30**(9): 2281-6.

45. Reyna VF, Nelson WL, Han PK, Dieckmann NF. How numeracy influences risk comprehension and medical decision making. Psychol Bull. 2009; **135**(6): 943-73.

46. Roter DL, Erby LH, Rimal RN, Smith KC, Larson S, Bennett IM, et al. Empowering Women's Prenatal Communication: Does Literacy Matter? Journal of health communication. 2015; **20**(sup2): 60-8.

47. Rosal MC, Goins KV, Carbone ET, Cortes DE. Views and preferences of low-literate Hispanics regarding diabetes education: results of formative research. Health Educ Behav. 2004; **31**(3): 388-405.

48. Ben-Shlomo Y, Kuh D. A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. Int J Epidemiol. 2002; **31**(2): 285-93.

49. Hall PA, Fong GT. Temporal self-regulation theory: A model for individual health behavior. Health Psychology Review. 2007; **1**(1): 6-52.

50. Djulbegovic B, Hozo I, Beckstead J, Tsalatsanis A, Pauker SG. Dual processing model of medical decision-making. BMC Med Inform Decis Mak. 2012; **12**: 94.

51. Giele JZaE, Glen H. Jr., editor. Methods of Life Course Research: Qualitative and Quantitative Approaches: Sage Publications; 1998.

52. Elder GH. The life course as developmental theory. Child Development. 1998; **69**(1): 1-12.

53. Darnton-Hill I, Nishida C, James WP. A life course approach to diet, nutrition and the prevention of chronic diseases. Public Health Nutr. 2004; **7**(1A): 101-21.

54. Dixon B, Pena MM, Taveras EM. Lifecourse approach to racial/ethnic disparities in childhood obesity. Adv Nutr. 2012; **3**(1): 73-82.

55. McBride CM, Emmons KM, Lipkus IM. Understanding the potential of teachable moments: the case of smoking cessation. Health Educ Res. 2003; **18**(2): 156-70.

56. Monte S, Valenti O, Giorgio E, Renda E, Hyseni E, Faraci M, et al. Maternal weight gain during pregnancy and neonatal birth weight: a review of the literature. J Prenat Med. 2011; **5**(2): 27-30.

57. Mantzari E, Vogt F, Marteau TM. The effectiveness of financial incentives for smoking cessation during pregnancy: is it from being paid or from the extra aid? BMC Pregnancy Childbirth. 2012; **12**: 24.

58. Storey JD, Saffitz, G.B., Rimon, J.G. Social Marketing. In: Glanz K, Rimer, B., and Vishwanath, K. , editor. Health Behavior and Health Education: Theory, Research and Practice (4th Ed) San Francisco, CA: Jossey-Bass; 2008.

59. Phelan S, Hart C, Phipps M, Abrams B, Schaffner A, Adams A, et al. Maternal behaviors during pregnancy impact offspring obesity risk. Exp Diabetes Res. 2011; **2011**: 985139.

60. Lawson PJ, Flocke SA. Teachable moments for health behavior change: a concept analysis. Patient Educ Couns. 2009; **76**(1): 25-30.

61. Stotland NE, Haas JS, Brawarsky P, Jackson RA, Fuentes-Afflick E, Escobar GJ. Body mass index, provider advice, and target gestational weight gain. Obstet Gynecol. 2005; **105**(3): 633-8.

62. Cogswell ME, Scanlon KS, Fein SB, Schieve LA. Medically advised, mother's personal target, and actual weight gain during pregnancy. Obstet Gynecol. 1999; **94**(4): 616-22.

63. Stengel MR, Kraschnewski JL, Hwang SW, Kjerulff KH, Chuang CH. "What my doctor didn't tell me": examining health care provider advice to overweight and obese pregnant women on gestational weight gain and physical activity. Womens Health Issues. 2012; **22**(6): e535-40.

64. Ornstein S, Nietert PJ, Jenkins RG, Wessell AM, Nemeth LS, Rose HL. Improving the translation of research into primary care practice: results of a national quality improvement demonstration project. Jt Comm J Qual Patient Saf. 2008; **34**(7): 379-90.

65. Beach MC, Saha S, Korthuis PT, Sharp V, Cohn J, Wilson I, et al. Differences in patient-provider communication for Hispanic compared to non-Hispanic white patients in HIV care. J Gen Intern Med. 2010; **25**(7): 682-7.

66. Glanz K, Basil M, Maibach E, Goldberg J, Snyder D. Why Americans eat what they do: taste, nutrition, cost, convenience, and weight control concerns as influences on food consumption. J Am Diet Assoc. 1998; **98**(10): 1118-26.

67. Glanz K, Yaroch AL. Strategies for increasing fruit and vegetable intake in grocery stores and communities: policy, pricing, and environmental change. Prev Med. 2004; **39 Suppl 2**: S75-80.

68. Zera CA, Nicklas JM, Levkoff SE, Seely EW. Diabetes risk perception in women with recent gestational diabetes: delivery to the postpartum visit. J Matern Fetal Neonatal Med. 2012.

69. Marteau TM, Hollands GJ, Fletcher PC. Changing human behavior to prevent disease: the importance of targeting automatic processes. Science. 2012; **337**(6101): 1492-5.

70. Peters E. A Perspective on Eating Behaviors from the Field of Judgment and Decision Making. Annals of Behavioral Medicine. 2009; **38**(0): 81-7.

71. Sobal J, Bisogni CA. Constructing food choice decisions. Ann Behav Med. 2009; **38 Suppl 1**: S37-46.

72. Hall PA, Fong GT, Cheng AY. Time perspective and weight management behaviors in newly diagnosed Type 2 diabetes: a mediational analysis. J Behav Med. 2011.

73. Daugherty JR, Brase GL. Taking time to be healthy: Predicting health behaviors with delay discounting and time perspective. Personality and Individual Differences. 2010; **48**(2): 202-7.

74. Gellert P, Ziegelmann JP, Lippke S, Schwarzer R. Future time perspective and health behaviors: temporal framing of self-regulatory processes in physical exercise and dietary behaviors. Ann Behav Med. 2012; **43**(2): 208-18.

75. Guthrie LC, Lessl K, Ochi O, Ward MM. Time Perspective and Smoking, Obesity, and Exercise in a Community Sample. American Journal of Health Behavior. 2013; **37**(2): 171-80.

76. Kahneman D. Maps of Bounded Rationality: Psychology for Behavioral Economics. American Economic Review. 2003; **93**(5): 1449-75.

77. Tversky A, Kahneman D. Judgment under Uncertainty: Heuristics and Biases. Science. 1974; **185**(4157): 1124-31.

78. Mukherjee K. A dual system model of preferences under risk. Psychol Rev. 2010; **117**(1): 243-55.

79. Prelec D, Loewenstein G. Decision making over time and under uncertainty: A common approach. Management science. 1991; **37**(7): 770-86.

80. Finnegan JRJ, Viswanath, K. Communication Theory and Health Behavior Change. In: Glanz K, Rimer, B., and Vishwanath, K. , editor. Health Behavior and Health Education: Theory, Research and Practice (4th Ed). San Francisco, CA: Jossey-Bass.; 2008.

81. Keller C, Siegrist M, Gutscher H. The role of the affect and availability heuristics in risk communication. Risk Anal. 2006; **26**(3): 631-9.

82. Slovic P, Peters E. Risk Perception and Affect. Current Directions in Psychological Science. 2006; **15**(6): 322-5.

83. Slovic P, Finucane, M. L., Peters, E., & MacGregor, D. G. . The affect heuristic. In: T.Gilovich DG, & D.Kahneman editor. Heuristics and Biases: The Psychology of Intuitive Judgment New York: Cambridge University Press; 2002. p. 397–420.

84. Slovic P, Finucane ML, Peters E, MacGregor DG. Risk as analysis and risk as feelings: some thoughts about affect, reason, risk, and rationality. Risk Anal. 2004; **24**(2): 311-22.

85. Rivers SE, Reyna VF, Mills B. Risk Taking Under the Influence: A Fuzzy-Trace Theory of Emotion in Adolescence. Dev Rev. 2008; **28**(1): 107-44.

86. Gneezy U, Meier S, Rey-Biel P. When and why incentives (don't) work to modify behavior. The Journal of Economic Perspectives. 2011; **25**(4): 191-209.

87. Evans JS. In two minds: dual-process accounts of reasoning. Trends Cogn Sci. 2003; **7**(10): 454-9.

88. Kamenica E. Behavioral economics and psychology of incentives. Annu Rev Econ. 2012; **4**(1): 427-52.

89. Fry JP, Neff RA. Periodic prompts and reminders in health promotion and health behavior interventions: systematic review. J Med Internet Res. 2009; **11**(2): e16.

90. Gittelsohn J, Lee K. Integrating Educational, Environmental, and Behavioral Economic Strategies May Improve the Effectiveness of Obesity Interventions. Applied Economic Perspectives and Policy. 2013; **35**(1): 52-68.

91. Croskerry P, Nimmo GR. Better clinical decision making and reducing diagnostic error. J R Coll Physicians Edinb. 2011; **41**(2): 155-62.

92. Johnson RB, Onwuegbuzie AJ. Mixed Methods Research: A Research Paradigm Whose Time Has Come. Educational Researcher. 2004; **33**(7): 14-26.

93. Yin R. Case study research: design and methods 4th ed. Thousand Oaks, CA: Sage Publications; 2009.

94. Ritchie J, Spencer, L. Qualitative data analysis for applied policy research. In: Bryman A, Burgess, R., editor. Analysing qualitative data. London: Routledge; 1993. p. 173–94.

95. Birks M, Chapman Y, Francis K. Memoing in qualitative research probing data and processes. Journal of Research in Nursing. 2008; **13**(1): 68-75.

96. Groenewald T. Memos and Memoing. In: Given LM, editor. Thousand Oaks Thousand Oaks, California: SAGE Publications, Inc.; 2008.

97. Chen L, Mayo R, Chatry A, Hu G. Gestational Diabetes Mellitus: Its Epidemiology and Implication beyond Pregnancy. Current Epidemiology Reports. 2016: 1-11.

98. Kim C, Berger DK, Chamany S. Recurrence of gestational diabetes mellitus: a systematic review. Diabetes Care. 2007; **30**(5): 1314-9.

99. Schwartz N, Nachum Z, Green MS. The prevalence of gestational diabetes mellitus recurrence--effect of ethnicity and parity: a metaanalysis. Am J Obstet Gynecol. 2015; **213**(3): 310-7.

100. Pabon-Nau LP, Cohen A, Meigs JB, Grant RW. Hypertension and diabetes prevalence among U.S. Hispanics by country of origin: the National Health Interview Survey 2000-2005. J Gen Intern Med. 2010; **25**(8): 847-52.

101. Hedderson MM, Darbinian JA, Ferrara A. Disparities in the risk of gestational diabetes by race-ethnicity and country of birth. Paediatr Perinat Epidemiol. 2010; **24**(5): 441-8.

102. Torres R. Access Barriers to Prenatal Care in Emerging Adult Latinas. Hispanic Health Care International. 2016; **14**(1): 10-6.

103. CDC. Summary Health Statistics for U.S. Adults: 2012. 2014.

104. Amaro H, de la Torre A. Public health needs and scientific opportunities in research on Latinas. Am J Public Health. 2002; **92**(4): 525-9.

105. Carbone ET, Rosal MC, Torres MI, Goins KV, Bermudez OI. Diabetes self-management: Perspectives of Latino patients and their health care providers. Patient Education and Counseling. 2007; **66**(2): 202-10.

106. Flegal KM, Ezzati TM, Harris MI, Haynes SG, Juarez RZ, Knowler WC, et al. Prevalence of diabetes in Mexican Americans, Cubans, and Puerto Ricans from the Hispanic Health and Nutrition Examination Survey, 1982-1984. Diabetes Care. 1991; **14**(7): 628-38.

107. Torres JM, Wallace SP. Migration circumstances, psychological distress, and self-rated physical health for Latino immigrants in the United States. American journal of public health. 2013; **103**(9): 1619-27.

108. Mary's Center for Maternal and Child Care webpage. [cited 2016 Feb 22]; Available from: http://www.maryscenter.org/

109. Zong J, and J. Batalova. Central American Immigrants in the United States. 2015 [cited 2016 Feb 22]; :[Available from: http://www.migrationpolicy.org/article/central-american-immigrants-united-states

110. Gestational Diabetes Mellitus. Diabetes Care. 2003; **26**(suppl 1): s103-s5.

111. Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN, et al. Recommendations for Blood Pressure Measurement in Humans and Experimental Animals: Part 1: Blood Pressure Measurement in Humans: A Statement for Professionals From the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. Hypertension. 2005; **45**(1): 142-61.

112. StataCorp. Stata Statistical Software: Release 11. College Station, TX: StataCorp LP; 2009.

113. Coustan DR, editor. Medical Management of Pregnancy Complicated by Diabetes. 5th ed; 2013.

114. Walker LO. Managing excessive weight gain during pregnancy and the postpartum period. J Obstet Gynecol Neonatal Nurs. 2007; **36**(5): 490-500.

115. Boghossian NS, Orekoya O, Liu J, Liu J. Pregnancy Interventions or Behaviors and Cardiometabolic Biomarkers: a Systematic Review. Current Epidemiology Reports. 2016: 1-12.

116. Chin JR, Murtaugh MA, Silver R. Obesity: Implications for Women's Reproductive Health. Current Epidemiology Reports. 2014; **1**(1): 17-26.

117. Mamun AA, Mannan M, Doi SAR. Gestational weight gain in relation to offspring obesity over the life course: a systematic review and bias-adjusted meta-analysis. Obesity Reviews. 2014; **15**(4): 338-47.

118. Cortes LM, Gittelsohn J, Alfred J, Palafox NA. Formative research to inform intervention development for diabetes prevention in the Republic of the Marshall Islands. Health Educ Behav. 2001; **28**(6): 696-715.

119. Sridhar SB, Darbinian J, Ehrlich SF, Markman MA, Gunderson EP, Ferrara A, et al. Maternal gestational weight gain and offspring risk for childhood overweight or obesity. Am J Obstet Gynecol. 2014; **211**(3): 259 e1-8.

120. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med. 2002; **346**(6): 393-403.

121. Who J, Consultation FE. Diet, nutrition and the prevention of chronic diseases. World Health Organ Tech Rep Ser. 2003; **916**(i-viii).

122. WorldHealthOrganization. Global report on diabetes. Geneva; 2016.

123. Sniehotta FF, Presseau J, Araújo-Soares V. Time to retire the theory of planned behaviour. Health Psychology Review. 2014; **8**(1): 1-7.

124. Caballero B. The global epidemic of obesity: an overview. Epidemiologic reviews. 2007; **29**(1): 1-5.

125. Coa KI, Smith KC, Klassen AC, Caulfield LE, Helzlsouer K, Peairs K, et al. Capitalizing on the "teachable moment" to promote healthy dietary changes among cancer survivors: the perspectives of health care providers. Support Care Cancer. 2015; **23**(3): 679-86.

126. Szwajcer EM, Hiddink GJ, Koelen MA, van Woerkum CMJ. Nutrition awareness and pregnancy: Implications for the life course perspective. European Journal of Obstetrics & Gynecology and Reproductive Biology. 2007; **135**(1): 58-64.

127. Szwajcer EM, Hiddink GJ, Koelen MA, Woerkum CMJ. Nutrition-related information-seeking behaviours before and throughout the course of pregnancy: consequences for nutrition communication. Eur J Clin Nutr. 2005; **59**.

128. Cranton P. Understanding and Promoting Transformative Learning: A Guide for Educators of Adults. Jossey-Bass Higher and Adult Education Series: ERIC; 1994.

129. Mezirow J. Transformative learning: Theory to practice. New directions for adult and continuing education. 1997; **1997**(74): 5-12.

130. Christie D, Channon S. The potential for motivational interviewing to improve outcomes in the management of diabetes and obesity in paediatric and adult populations: a clinical review. Diabetes Obes Metab. 2014; **16**(5): 381-7.

131. Lundahl B, Moleni T, Burke BL, Butters R, Tollefson D, Butler C, et al. Motivational interviewing in medical care settings: a systematic review and meta-analysis of randomized controlled trials. Patient Educ Couns. 2013; **93**(2): 157-68.

132. Emmons KM, Rollnick S. Motivational interviewing in health care settings. Opportunities and limitations. Am J Prev Med. 2001; **20**(1): 68-74.

133. Mennella JA, Jagnow CP, Beauchamp GK. Prenatal and postnatal flavor learning by human infants. Pediatrics. 2001; **107**(6): E88.

134. Ferrara A, Hedderson MM, Quesenberry CP, Selby JV. Prevalence of Gestational Diabetes Mellitus Detected by the National Diabetes Data Group or the Carpenter and Coustan Plasma Glucose Thresholds. Diabetes Care. 2002; **25**(9): 1625-30.

135. Bardenheier BH, Imperatore G, Gilboa SM, Geiss LS, Saydah SH, Devlin HM, et al. Trends in Gestational Diabetes Among Hospital Deliveries in 19 U.S. States, 2000-2010. Am J Prev Med. 2015; **49**(1): 12-9.

136. Facchinetti F, Dante G, Petrella E, Neri I. Dietary interventions, lifestyle changes, and dietary supplements in preventing gestational diabetes mellitus: a literature review. Obstet Gynecol Surv. 2014; **69**(11): 669-80.

137. Kumanyika SK, Bowen D, Rolls BJ, Van Horn L, Perri MG, Czajkowski SM, et al. Maintenance of dietary behavior change. Health Psychology. 2000; **19**(1, Suppl): 42-56.

138. Ayala GX, Ibarra L, Arredondo E, Horton L, Hernandez E, Parada H, et al. Promoting healthy eating by strengthening family relations: design and implementation of the Entre Familia: Reflejos de Salud intervention. Cancer disparities: Causes and evidence-based solutions. 2011: 237-52.

139. Elder JP, Ayala GX, Parra-Medina D, Talavera GA. Health communication in the Latino community: issues and approaches. Annu Rev Public Health. 2009; **30**: 227-51.

140. Katiria Perez G, Cruess D. The impact of familism on physical and mental health among Hispanics in the United States. Health Psychology Review. 2014; **8**(1): 95-127.

141. Luthar SS, Cicchetti D, Becker B. The construct of resilience: A critical evaluation and guidelines for future work. Child Development. 2000; **71**(3): 543-62.

142. Rutter M. Psychosocial resilience and protective mechanisms. American Journal of Orthopsychiatry. 1987; **57**(3): 316-31.

143. Roszler JaWSR. Approaches to Behavior: Changing the dynamic between patients and professionals in diabetes care and education. Alexandria: American Diabetes Association; 2015.

144. Harvey JR, Ogden DE. Obesity treatment in disadvantaged population groups: where do we stand and what can we do? Prev Med. 2014; **68**: 71-5.

145. Trudnak TE, Arboleda E, Kirby RS, Perrin K. Outcomes of Latina women in CenteringPregnancy group prenatal care compared with individual prenatal care. J Midwifery Womens Health. 2013; **58**(4): 396-403.

146. Mary'sCenter. The Centering Pregnancy Model of Care. 2016 [cited 2016 Mar 27]; Available from: http://www.maryscenter.org/article/centering-pregnancy-model-care

147. Mantzari E, Vogt F, Shemilt I, Wei Y, Higgins JP, Marteau TM. Personal financial incentives for changing habitual health-related behaviors: A systematic review and meta-analysis. Prev Med. 2015; **75**: 75-85.

148. Mary'sCenter. Our Model. 2016 [cited 2016 April 5]; Available from: http://www.maryscenter.org/our-model

M.3. Curriculum Vitae

KATHERINE LEE

katherinelee8@gmail.com

EDUCATION

2010-2016
Doctorate of Philosophy (PhD) in Social and Behavioral Sciences
Department of Health, Behavior and Society
Johns Hopkins Bloomberg School of Public Health; Baltimore, MD.
Advisor: J. Douglas Storey, Ph.D.

2004-2006
Master of Arts (MA) in Sociology;
Concentration in Social Psychology and Interpersonal Processes
Stanford University, Stanford, CA.

2002-2006
Bachelor of Arts (BA) in Psychology with Honors; minor in Biological Sciences
Stanford University, Stanford, CA.

RESEARCH EXPERIENCE

2011-2016 **Research Investigator**

Mary's Center, Washington, D.C. & Johns Hopkins Bloomberg School of Public Health
Conceived of study in collaboration with a Federally Qualified Health Center that provides maternal and child care services to individuals whose needs often go unmet by public and private systems. Received support from Center for a Livable Future and Department of Health, Behavior and Society for independent research leading to dissertation study. Worked alongside key stakeholders to design and implement qualitative and quantitative research study on healthy eating promotion and diabetes prevention for low-income Central American immigrants accessing prenatal care.

2013-2014 **Research Assistant**

Exploring Provider Perception of Parent-Child Interaction in Pediatric Primary Care
Department of Pediatrics, Johns Hopkins School of Medicine
Conducted qualitative study in collaboration with postdoctoral fellow. Assisted with refining and pretesting interview field guides, recruiting participants, conducting interviews, coding and transcription of interviews, and analysis of data for qualitative study on parent-child interaction (PCI) observation and feedback. Conducted interviews with pediatric residents (n=16) practicing at Johns Hopkins to ascertain how residents characterize PCI and to identify factors influencing their observation of and feedback on PCI. Recruited and assisted with conduct of focus groups (n=2) for mothers of children 6-12

months old to explore parent preferences for pediatric provider feedback on PCI. (Principal Investigator: Anne Duggan, ScD, funded by The Pediatric Academic Society)

2010-2012 **Research Assistant**

Social and Behavior Change Interventions Landscaping Study: A Global Review
Center for Communication Programs, Johns Hopkins Bloomberg School of Public Health
Prepared global report for the Family Health Division of The Bill & Melinda Gates Foundation to inform the Foundation's development of a behavior change division; conducted a comprehensive literature search, provided analysis and interpretation of findings. Supervised team of four master's level research assistants with weekly reports, guidance, and group meetings with the principal investigator. Served as a rapporteur for the Gates Foundation social and behavior change convening attended by 150 invited experts in the field: Achieving lasting impact at scale: Social and behavior change and the spread of family health interventions in low-income countries, 1-2 November 2011, Seattle, WA. Assisted with presentations, breakout sessions, and summarized findings from the convening into a report later distributed to attendees. (Principal Investigator: J. Douglas Storey, Ph.D., funded by The Bill & Melinda Gates Foundation)

2007-2010 **Data Coordinator**

Fresh Start Study: Behavioral Strategies for Healthy Weight
Stanford Prevention Research Center, Stanford School of Medicine
Held primary responsibility for management, collection, and processing of all quantitative and qualitative study data for 3-year randomized, behavioral weight management R01 clinical trial. Performed quality control checks and initial data analyses using SAS analytical software; designed and maintained online participant questionnaires; led protocol modifications for Institutional Review Board; coordinated recruitment of 267 women from the San Francisco Bay Area; assisted with preparation of health education classes. (Principal Investigator: Michaela Kiernan, Ph.D., National Cancer Institute Grant R01 CA112594)

2007-2008 **Research Assistant**

Maintenance First Study
Stanford Prevention Research Center, Stanford School of Medicine
Coordinated data management and collection for 6-month weight maintenance clinical trial (n=24). Pilot study developed and tested "stability skills" intervention modules for the NCI R01 clinical trial. Instituted online system for participant screening; streamlined the design and administration of online surveys; developed novel data analytic methods in collaboration with statistical programmer; conducted study clinic assessments; prepared presentation and results for study results for participants. (Principal Investigator: Michaela Kiernan, Ph.D., American Heart Association Grant)

2004-2006 **Senior Honors Research**

Tsai Culture and Emotion Lab
Department of Psychology, Stanford University
Conducted psychology undergraduate honors thesis to construct a measure for compassionate affect, attitudes, and behavior; recruited large community sample (n= 352)

in the San Francisco Bay Area; refined qualitative coding system; trained and supervised undergraduate research assistants to code qualitative data with validity checks; conducted statistical analyses using SPSS (Thesis Advisor: Jeanne L. Tsai, Ph.D.; Senior Honors Advisor: Philip G. Zimbardo, Ph.D.)

2005-2006 **Research Assistant**

Emotion Coding Lab: Stanford Psychiatry & Behavioral Medicine,
Stanford Hospital & Clinics
Coded emotional expression and facial affect of breast cancer support group participants from videotape recordings of support group sessions; coded emotional expressions via Specific Affect Coding System (SPAFF)
(Principal Investigators: Janine Giese-Davis, Ph.D., David Spiegel, M.D.)

TEACHING EXPERIENCE

2012-2014 **Teaching Assistant**

Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD
The Role of Non-Governmental and Community-Based Organizations in Improving Global Public Health; 301.692.51 (Winter 2012, 2013, 2014)

2012-2013 **Teaching Assistant**

Department of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD
Health Communication Programs; 410.654.01/410.655.01 (Winter/Spring 2012, 2013); Provided technical guidance for students conducting health communication campaigns at Johns Hopkins from analysis, implementation, to evaluation; evaluated assignments and final projects.

2012-2013 **Teaching Assistant**

Department of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD
A New View: Improving Public Health through Innovative Social and Behavioral Tools and Approaches; 410.614.11 (June 2012)

2012 **Invited Speaker**

Intersections monthly seminar series (May 2012)
Department of Health, Behavior and Society
Participated in panel discussion with departmental faculty panelists to discuss Gates Foundation report on social & behavioral interventions. The seminar series is designed with the goal of generating inquiry and discussion relevant to a broad spectrum of interests within public health.

2009 **Invited Speaker**

Career Development Roundtable (May 2009)
Stanford Prevention Research Center
Prepared and presented "Practical Tools for Recruitment and Retention" seminar with research team on clinical trial recruitment methods, covering design of materials through screening and study enrollment; audience of postdoctoral fellows.

2008 **Teaching Assistant**

Stanford University School of Medicine
Methods in Community Assessment, Evaluation, and Research (Spring 2008)
Assisted in required course for first year Stanford medical school students in the Scholarly Concentration of Community Health. Prepared and facilitated small-group experiential class activities demonstrating research methods; assisted in preparation of course materials; designed and graded examinations.

2008 **Guest Lecturer**

Stanford University School of Medicine
Methods in Community Assessment, Evaluation, and Research (March 2008)
Developed and presented "Race and Ethnicity Reporting" module on use of race and ethnicity health statistics in clinical trials. Facilitated experiential class activity on reporting statistics and moderated discussion.

MANUSCRIPTS

Abel, M. L., **Lee, K.**, Loglisci, R., Righter, A., Hipper, T. J., Cheskin, L. J. (2015). Consumer Understanding of Calorie Labeling: A Healthy Monday E-Mail and Text Message Intervention. *Health Promotion Practice.* 16(2):236-43. doi: 10.1177/1524839914543105.

Trude, A.C., Kharmats, A., Jock, B., Liu, D., **Lee, K.**, Martins, P.A., Pardilla, M., Swartz, J., and Gittelsohn, J. (2015). Patterns of Food Consumption are Associated with Obesity, Self-Reported Diabetes and Cardiovascular Disease in Five American Indian Communities. *Ecology of Food and Nutrition*. 54(5):437-54. doi: 10.1080/03670244.2014.922070.

Gittelsohn, J. and **Lee, K**. (2013). Integrating Educational, Environmental, and Behavioral Economic Strategies May Improve the Effectiveness of Obesity Interventions. *Journal of Applied Economic Perspectives and Policy*. 35(1): 52-68. doi: 10.1093/aepp/pps044.

Kiernan, M., Schoffman, D.E., **Lee, K.**, Brown, S.D., Fair, J.M., Perri, M.G., & Haskell, W.L. (2013). The Stanford Leisure-Time Activity Categorical Item (L-Cat): A Single Categorical Item Sensitive to Physical Activity Changes in Overweight/Obese Women. *International Journal of Obesity.* 37(12):1597-602. doi: 10.1038/ijo.2013.36.

Kiernan, M., Brown, S. D., Schoffman, D. E., **Lee, K.**, King, A. C., Taylor, C. B., Schleicher, N.C., & Perri, M. G. (2012). Promoting Healthy Weight With "Stability Skills First": A Randomized Trial. *Journal of Consulting and Clinical Psychology*. 81(2):336-46. doi: 10.1037/a0030544

Brown, S. D., **Lee, K.**, Schoffman, D. E., King, A. C., Crawley, L. M., & Kiernan, M. (2012). Using direct mail to enhance minority recruitment into clinical trials: Experimental findings and

practical recommendations. *Contemporary Clinical Trials*. 33(4):620-3. doi: 10.1016/j.cct.2012.03.003

Kiernan M., Moore, S.D., Schoffman, D.E., **Lee, K.**, King, A.C., Taylor, C.B., Kiernan, N.E., and Perri, M.G. (2011). Social Support for Healthy Behaviors: Scale Psychometrics and Prediction of Weight Loss Among Women in a Behavioral Program. *Obesity*. (*Silver Spring).* 20(4): 756-764. doi: 10.1038/oby.2011.293

PUBLISHED REPORTS

Storey, J.D., **Lee, K.**, Blake, C., Lee, P., Lee, H.Y., Depasquale, N. (2011). Social and behavior change interventions landscaping study: A global review. Report prepared for the Family Health Division of The Bill & Melinda Gates Foundation. Center for Communication Programs, Johns Hopkins Bloomberg School of Public Health.

Storey, J.D. & **Lee, K.** (2011). Achieving lasting impact at scale: Social and behavior change and the spread of family health interventions in low-income countries. Findings from the social and behavior change convening, 1-2 November 2011, Seattle, WA. Center for Communication Programs, Johns Hopkins Bloomberg School of Public Health.

CONFERENCE PRESENTATIONS

Lee K. and Storey, J.D. (2016, June). Capitalizing on Teachable Moments for Healthy Eating and Diabetes Prevention Among Low-Income Central American Immigrants. Accepted for paper presentation for the 66th Annual Meeting of the International Communication Association. Fukuoka, Japan.

Palaia A., Mendelsohn A., Duggan A., and **Lee K.** (2014, May). Pediatrician Observation and Communication Surrounding Parent-Child Interaction. Accepted as a poster presentation (Abstract #: 751031) for the Pediatric Academic Societies Meeting, Vancouver, BC.

Kiernan M., **Lee K.,** Schoffman D., Moore S. D., Fair J., Taylor-Piliae R., Perri M. G., Haskell W. L. (2011, April). Using the revised Stanford Brief Activity Survey (SBAS-R) to assess changes in leisure-time activity among obese women. Accepted as a poster presentation for the 32nd Annual Meeting of the Society of Behavioral Medicine, Washington, DC.

Kiernan M., Moore S. D., Schoffman D., **Lee K.**, King A. C., Taylor C. B., Perri M. G. (2011, April). Lack of social support from friends predicts successful weight loss in a group-based program. Accepted as a poster presentation for the 32nd Annual Meeting of the Society of Behavioral Medicine, Washington, DC.

Kiernan M., Moore S. D., Schoffman D., **Lee K.**, King A. C., Taylor C. B., Perri M. G. (2011, April). Promoting healthy weight with 'Stability First'. In M. Kiernan (Chair), *Alternative approaches to long-term weight management: Paradox and proof*. Symposium accepted for presentation at the 32nd Annual Meeting of the Society of Behavioral Medicine, Washington, DC.

Moore S. D., **Lee K.**, Schoffman D., King A. C., Crawley L. M., & Kiernan M. (2011, April). Using direct mail to enhance ethnic minority recruitment to clinical trials: Experimental findings and practical recommendations. In S.D. Moore (Chair), *Evaluating strategies to optimize*

minority recruitment in health behavior change research. Symposium accepted for presentation at the 32nd Annual Meeting of the Society of Behavioral Medicine, Washington, DC.

Kiernan, M., Moore, S. D., **Lee, K.**, Schoffman, D., King, A. C., Taylor, C. B., Kraemer, H. C., & Perri, M. G. *Low initial levels of perceived social support for healthy eating and activity indicate room for intervention.* Presented at the Society of Behavioral Medicine 2010 Annual Meeting and Scientific Sessions in Seattle, WA.

Lee, K. *Are Meditators More Compassionate? Design and Test of a Measure of Compassion*. Poster presented at the 2006 Stanford Undergraduate Psychology Conference in Stanford, CA.

PEER-REVIEWED PUBLISHED ABSTRACTS

Kiernan, M., Moore, S. D**.**, **Lee, K.**, Schoffman, D., King A. C., Taylor, C. B., Kraemer, H. C., & Perri, M. G. (2010). Low initial levels of perceived social support for healthy eating and activity indicate room for intervention. *Annals of Behavioral Medicine*, 39, s40.

PROFESSIONAL MEMBERSHIPS

2013-Present Member, International Communication Association
2010-2013 Member, Society of Behavioral Medicine
2010-2012 Member, American Public Health Association

JOURNAL REVIEWER

2016 Women's Health Issues

GRANT REVIEWER

2014 Diabetes UK, the British Diabetic Association

HONORS AND AWARDS

Doctoral Distinguished Research Award
Department of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health (2013-14, 2014-15)
Departmental research award for doctoral students who have successfully passed their preliminary oral examination in support of their thesis research. Awards are made on a competitive basis, considering relevance of the research to the Department's mission, innovation, and appropriateness of design and methods.

Center for a Livable Future- Lerner Fellowship, Pre-doctoral fellow
Johns Hopkins Bloomberg School of Public Health (2011-12, 2012-13)
As Pre-doctoral fellow, supported CLF aims to promote research and to develop and communicate information about the complex interrelationships among diet, food production, environment and human health. The Center's Fellowship program supports doctoral students at Johns Hopkins University who are committed to the discovery and/or

application of knowledge about the public health challenges associated with our current food system, and/or about creating a healthier and more resilient food system.

Doctoral Special Project Funding
Dept of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health (2011-12, 2012-13, 2013-2014)
Special Project Funding awarded to doctoral students within the department on a competitive basis, considering relevance to the Department's mission.

Student Assembly Departmental Representative
Dept of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health (2011-2012)
The Student Assembly relies on strong leadership and dedicated members in order to fulfill its mission of representing, preserving and promoting the interests of all students at the Bloomberg School. One representative selected per department to liaison with the Student Assembly. Served on the Community Service and Honors and Awards committees and attended general meetings.

PROFESSIONAL DEVELOPMENT

Skills: Microsoft Office, SAS/SPSS/STATA statistical programs, Atlas.ti qualitative project software
Languages**: Spanish (professional working fluency), Mandarin Chinese (conversational fluency)**